National Aeronautics and Space Administration

# THE CRITICAL PATH

A FLIGHT PROJECTS DIRECTORATE PUBLICATION ■ 2020 SPRING ISSUE

A New Angle on the Sun

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**First to 'See' Sun's Poles**

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**FLIGHT PROJECTS DIRECTORATE | Volume 28 • Number 1**

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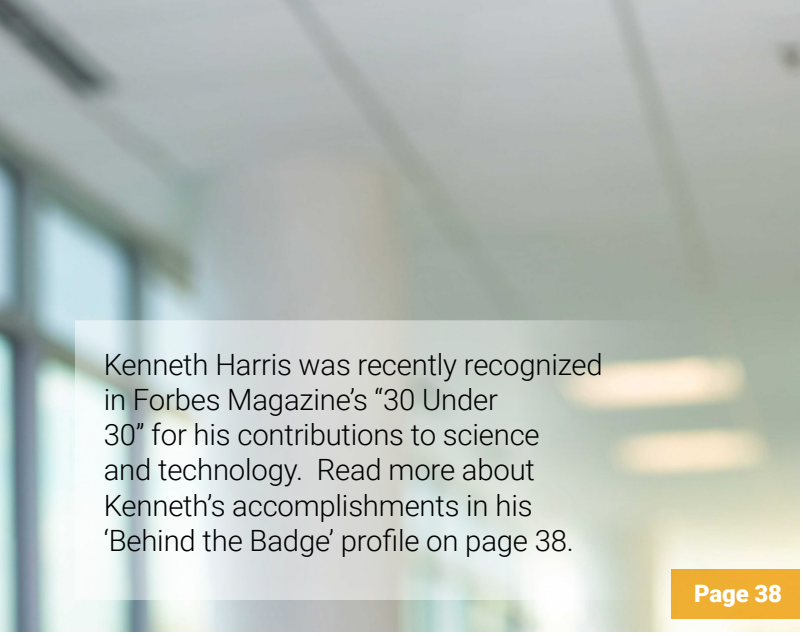

Kenneth Harris was recently recognized in Forbes Magazine's "30 Under 30" for his contributions to science and technology. Read more about Kenneth's accomplishments in his 'Behind the Badge' profile on page 38.

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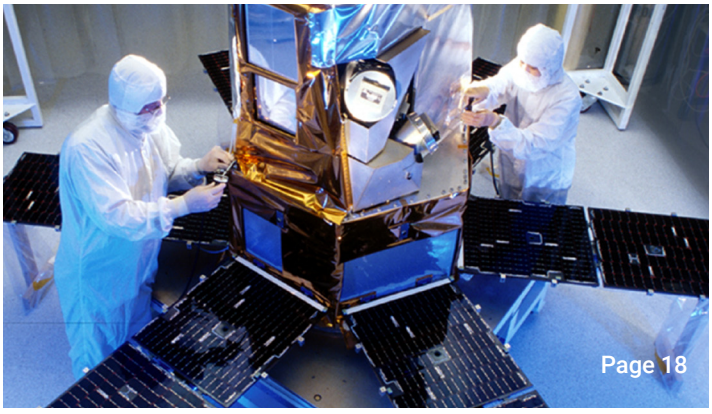

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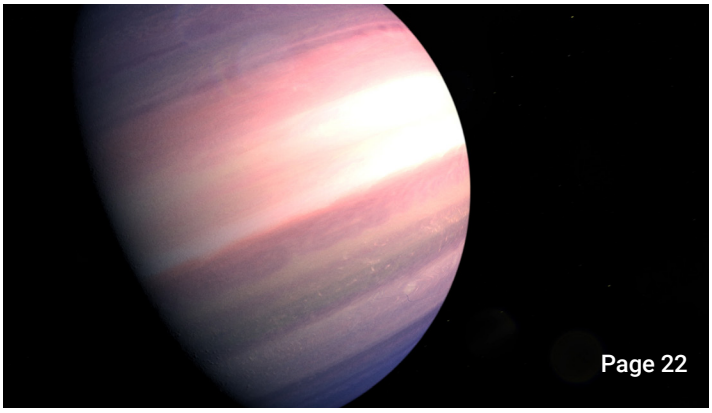

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# THE CRITICAL PATH

A FLIGHT PROJECTS DIRECTORATE PUBLICATION | 2020 SPRING ISSUE



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**Have a story idea, news item or letter for The Critical Path?**

Let us know about it. Include your **name, phone number** and send it to:

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The deadline for the next issue is **July 15, 2020**

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# Message from the DIRECTOR

Welcome to another edition of The Critical Path. Well folks, we are living through extraordinary times with the onset of the COVID-19 pandemic, something that this country has not seen the likes of in over a century. At the time of this writing, about 5% of the workforce is coming through the gates of Goddard-Greenbelt as we maximize telework for the safety of our people. Despite this significant challenge, much of our work continues in a remote fashion, and our onsite teams continue to safely fly our spacecraft, keep our networks operating, and maintain our critical infrastructure. I greatly appreciate everybody's perseverance as we navigate through these uncertain times.

On a very positive note, we welcome both Dennis Andrucyk as Center Director and Anne Kinney as Deputy Center Director. I have had the pleasure of working with both Dennis and Anne in years past and am excited to be working closely with them again, along with Christyl Johnson and Ray Rubilotta in Code 100.

On the mission side, there were many significant milestones over the past quarter, including the successful Solar Orbiter launch and early mission operations, the DSCOVR recommissioning, OSIRIS-REx rehearsals and flyovers in advance of the August 2020 tag event with the asteroid Bennu, SGSS end-to-end contacts with several spacecraft on orbit, WFIRST confirmation, JPSS-3 and JPSS-4 confirmation, PACE mission Critical Design Review,

*Attendees at the 2020 AAAC Retreat included: Back Row: Earlene Trott, Trena Ferrell, Iman Watson, DeWayne Washington, Tryshanda Moton, Sherley Jones, Henry Lane, Tonjua Hines-Watts, Denise Cervantes, Cheryl Johnson, Roland Wescott; Front Row: Wanda Peters, David Mitchell, Carlton Peters, Samuel Henry, David Pierce.* CREDIT: NASA / WFF

*On January 9, 2020, Dave hosted pizza lunch for students from the College of William and Mary (W&M), Virginia. Their day-long tour included a panel discussion with GSFC W&M alumni, including FPD's Candace Carlisle, a hyperwall presentation, tours of the Robotics Operations Center, Lunar Mission Operations Center, clean room and integration and test facility.* CREDIT: DONNA SWANN

LCRD payload completion at Goddard and shipment to the spacecraft facility in Virginia, significant progress on the Restore-L spacecraft in California, and JWST integration and test in California as it marches toward launch next year. Additionally, over the past quarter we have received "new starts" by way of directed missions to Goddard/FPD with the GeoCarb, GEO-XO (a GOES mission that will study geostationary earth orbits (GEO) and extended orbits (XO)), Hermes (part of Lunar Gateway program that will be hosted on the International Space Station), and Landsat Next missions.

Other exciting news is the selection of our next Flight Projects Development Program (FPDP) "cohort." We have been very intentional on replenishing our pipeline through an expansion of the FPDP. Please welcome the following people to the FPD family: Kristen Brown, Milton Davis, Corina Koca, Adam Matuszeski, Andrea Poulin, Chetan Sayal, Melanie Crespo, Joseph Hickman, and Freda Kagere. All nine of these individuals have been matched with their first of two one-year assignments which will provide them with fast track leadership opportunities, while directly benefitting their new projects.

Also, on the people front, I want to highlight a retreat that I participated in with the African American Advisory Committee (AAAC) at the Wallops Flight Facility in January. There were many powerful stories and takeaways from this retreat. We have work to do going forward, but I am optimistic about the possibilities and the future. If anybody would like to learn more about this activity and/or joining the AAAC, feel free to reach out to me as the AAAC senior champion or Carlton Peters (Code 545), AAAC chairman.

In closing, I'd like to wish everybody good health and safety in these very uncertain times. Please take some time to check in with your families, friends and colleagues to make sure that they are OK. Let us know if there is anything we can do in the front office to make things a little less stressful during the pandemic. Take good care. ■

**David F. Mitchell**
*Director, Flight Projects*
david.f.mitchell@nasa.gov

# A WORD FROM THE DEPUTY

**Dr. Wanda Peters shares her thoughts on taking some time to appreciate our colleagues.**

## Celebrating What We Do

While we continue to operate during these challenging times of a global pandemic, it may be an excellent time to reflect on the work we do and how it impacts our community. During challenging times, I have found it helpful to celebrate small, medium, and large accomplishments. These accomplishments can be ones that I have accomplished, however I have found that acknowledging and celebrating the accomplishments of others provides me with the greatest satisfaction. So, how can we celebrate what we do?

May 1st begins performance review time for several of our employees. This is a great opportunity for you to document all the great things you have accomplished during the past performance year through submitting a self-assessment to your supervisor. It is also a good time for you to celebrate the work of others by providing performance feedback of co-workers to their supervisors.

Another way to celebrate ourselves and others is to nominate someone for an award. There are several award calls (Peers, Robert H. Goddard, Agency Honors, etc…) throughout the year. Sometimes we just forget or do not take the time to recognize others or ourselves. Taking the time to recognize someone's contribution in the workplace conveys a powerful message to the recipient and the community. Also know that it is okay to nominate yourself or request that you be nominated for an award. When you have made a significant contribution to the workplace, it is important to celebrate yourselves through self-nomination or through a conversation with your supervisor or co-worker requesting that they nominate you for an award. Just being nominated for an award communicates to the individual that what they did individually or collectively with a group matters and had a meaningful impact. Most people would greatly appreciate being recognized for their work. Would you?

Often, it is very worthwhile for me to slow down and be very intentional about observing what is happening around me. I tend to discover things that I might have overlooked if not for taking the time to truly see. I find that celebrating what we do could be as simple as sending a note or email of thanks, appreciation, or recognition to someone for doing an outstanding job, making a positive difference in someone's day. A kind word can go very far in making someone's day special. Given the busy nature and fast pace of our workplace, sometimes we need to slow down and appreciate the extraordinary work being accomplished by our magnificent workforce at Goddard. Let's all stop, smell the roses, and celebrate what we do. I, for one, greatly appreciate the work you do for Goddard and I am forever thankful for being able to work with you! ■

*(left to right): Dave Mitchell (400), Sharon Straka (400), Wanda Peters (400), and Jay Pittman (100) visit the world's largest wind tunnel at Ames Research Center.*
CREDIT: NASA

Flight Projects Director Dave Mitchell, Deputy Director for Planning and Business Management, Dr. Wanda Peters, FPD Chief of Staff, Sharon Straka, and Assistant Director for Strategic Integration, Jay Pittman visited Ames Research Center (ARC) on January 23, 2020 for a Senior Executive Dialog with ARC management. As part of the meeting, they were given a tour of the facilities, including the impressive wind tunnel, to demonstrate ARC capabilities for future partnerships.

## Learn More

The largest wind tunnel in the world is the 80- by 120-foot, located at NASA's Ames Research Center.

Built in the early 1980's, the 80- by 120-foot is an open circuit tunnel. Air is drawn from the huge 360-foot wide, 130-foot high air intake, passes through the 120-foot wide, 80-foot high test section and then is expelled to the atmosphere. The maximum airspeed through the test section is 115 mph. Power is derived from six 40-foot diameter fan blades, each motor rated at 23,500 hp. The 80-by 120-foot tunnel is capable of testing aircraft as large as a Boeing 737. The wind tunnel began regular operations in 1987.

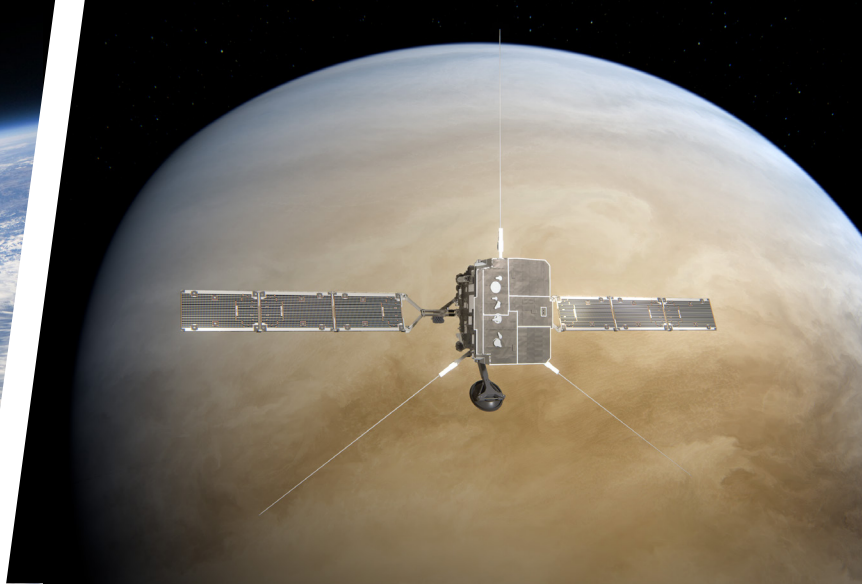
O https://www.nasa.gov/centers/ames/orgs/aeronautics/windtunnels/index.html

# A NEW ANGLE ON THE SUN

## SOLAR ORBITER FIRST TO 'SEE' SUN'S POLES

When Solar Orbiter orbits close to the Sun at 20 degrees off the solar equator, we will have the first clear images of our star's poles.


*Artist's impression of the fairing release.* CREDIT: ESA



*Artist's impression of Solar Orbiter making a flyby at Venus.* CREDIT: ESA

In its seven-year primary mission, Solar Orbiter will reach an inclination of 24 degrees above the Sun's equator, which could increase to 33 degrees during a potential three-year extended mission. At closest approach, the spacecraft will pass within 26 million miles of the Sun. The mission is a partnership between NASA and the European Space Agency (ESA), and is in line with both agencies' solar science objectives.

"This mission will allow us to observe the Sun's poles and to track the flows of magnetized plasma to the equator," NASA deputy project scientist Teresa Nieves Chinchilla said.

Like Parker Solar Probe, Solar Orbiter will use multiple gravity assists from Venus to help get it closer to the Sun, but it will also use the planet's gravity to bend its orbit off of the ecliptic plane formed by the Sun's equator. This gives the mission a vantage point unique from Earth and every other satellite in the plane that includes the planets.

Solar Orbiter could revolutionize our understanding of the solar wind: the flow of particles generated and propelled by the Sun that bathes our solar system. Solar Orbiter will be close enough to not only to observe the details of how the solar wind bubbles up from the Sun, but also to sample the wind shortly after it leaves the surface.

"There are things we don't understand about our Sun," Nieves-Chinchilla said. "We know that it basically works as a dynamo, but we are missing critical pieces to really understand our star." Crucially, the poles are still missing from space weather models scientists use to forecast solar activity.

To understand our turbulent star and its solar storms, she and other scientists monitor the Sun's magnetic field through techniques which work best with a straight-on view; the shallower the viewing angle, the noisier the data. The sidelong glimpse we get of the Sun's poles from Earth or satellites within the ecliptic plane leaves major gaps in our understanding.

The Sun's poles are extreme regions unlike the rest of the Sun, covered in coronal holes: cooler regions where fast solar wind comes gushing forth. There, scientists seek clues to understanding the knotted magnetic fields driving solar activity. They also hope to better understand what drives the roughly 11-year solar cycle, when the Sun swings between seasons of high and low activity.

The only other spacecraft that flew over the Sun's poles was also a joint ESA/ NASA venture, launched in 1990. Ulysses orbited our star three times

*Solar Orbiter launched atop the US Atlas V 411 rocket from Kennedy Space Center February 10, 2020.* CREDIT: ESA

*Continued on page 10*

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*(left) Solar Orbiter prepares to roll out to the launch pad at Cape Canaveral, Florida. (right) SOC Goddard Team.* CREDIT: ULA

before its decommissioning in 2009. Ulysses never got closer to the Sun than Earth, and only carried what's known as in situ instruments; like the sense of touch, those sensors measure the space environment surrounding the spacecraft. Solar Orbiter, for comparison, will pass inside the orbit of Mercury and carries four in situ instruments and six remote-sensing imagers, which see the Sun from afar. "We are going to be able to map what we 'touch' with the in situ instruments to what we 'see' with remote sensing," said Nieves-Chinchilla.

## Sister Missions

Solar Orbiter will be the second major mission to monitor the Sun from the inner solar system, following the August 2018 launch of Parker Solar Probe. Parker has completed four close solar passes and will fly within four million miles of the Sun at closest approach. For comparison, Solar Orbiter will come with 27 million miles of the Sun. Although Parker will travel closer to the Sun, Solar Orbiter will take the closest ever images of the Sun's surface.

The two orbiters will work together. As Parker samples solar particles up close, Solar Orbiter will capture imagery from farther away. The spacecraft will also occasionally align to measure the same magnetic field lines or streams of solar wind at different times.

The missions will be able to help calibrate and validate each other's observations, Nieves Chinchilla said. "Both teams have been working together for all these years to improve the outcomes and collaboration between these two missions," she said. "Multi-point and multi-view observations are very important to build the 3D images and understanding of our Sun."

The different viewing angle, along with Stereo A's view from an Earth-like orbit, will provide complete high-resolution imagery of the entire Sun for the first time.

"Now we have images of the plasma moving away from the Sun through the solar system from multiple angles," said Haydee Maldonado, project manager for NASA's contribution to the international mission. "We will have three sets of the same instruments. It's going to bring us a picture of the plasma as it transits through the helio atmosphere that we've never had before."

## Beating the Heat

The technology to go to the Sun as close as Parker Solar Probe or Solar Orbiter has only been available for 10 or 15 years, Maldonado said. "You have all the worst environments put together in one mission: electrostatic, heat, even cold."

To survive its close approaches to our star, Solar Orbiter's titanium heat shield must withstand temperatures over 900 degrees Fahrenheit (500 degrees C). The shield measures 10 feet by 8 feet, and is built like a sandwich. The front layer — wafer-thin layers of titanium foil, the outermost of which is coated with "SolarBlack", a material made of calcium phosphate — strongly reflects heat. A

honeycomb-patterned aluminum base, covered in more foil, forms the inner layer closest to the spacecraft.

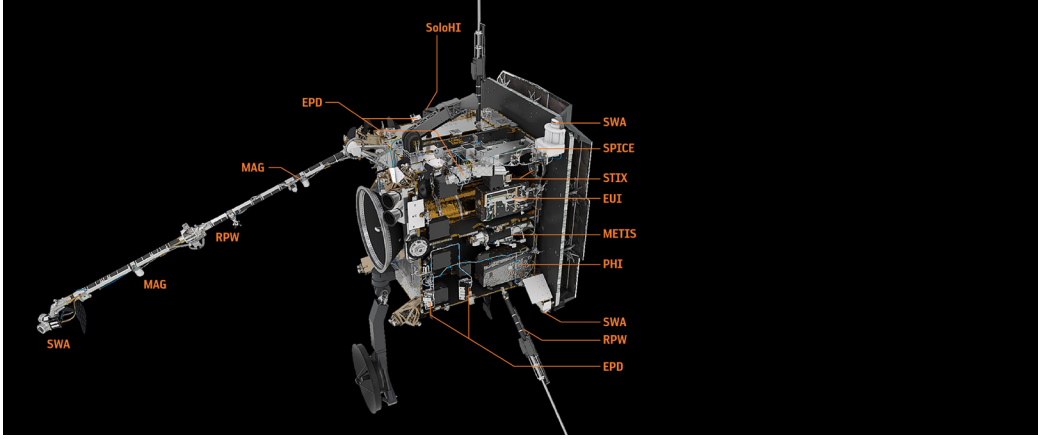
Star-shaped titanium brackets keep these layers in place. The nearly 10-inch gap between these layers funnels heat out to space, while a smaller one, between the inner layer and the spacecraft, further helps distance the working electronics from the heat. Overall, the shield is 15 inches thick. Five of the spacecraft's remote-sensing instruments will peer through feedthroughs in the heat shield.

Solar Orbiter has to contend with both direct solar heating on the externally mounted instruments as well as heating through the instrument apertures Panels of radiators on the side of the spacecraft eject heat and ensure the instruments don't get too hot.

"For this to come to fruition, it's a little bit emotional for me as an engineer," Maldonado said. "I have seen the changes in miniaturized electronics, new materials to allow proximity to the Sun. It has been decades in the making."

## Meet the Instruments

Under Maldonado's leadership, NASA provided one instrument and one sensor to the Solar Orbiter mission, coordinated by the NASA project office at Goddard. The Solar Orbiter Heliospheric Imager (SoloHI) is a wide field, visible light imaging telescope, with a one-shot door that will be opened once the mission is in its cruise phase.




*Cutaway view of Solar Orbiter's suite of ten science instruments.* CREDIT: ESA

NASA also provided the Heavy Ion Sensor (HIS), which is part of the Solar Wind Analyser instrument (SWA). This ion composition sensor will measure the 3D velocity distributions and composition of helium and heavy ions. It measures particle time of flight, azimuth and total energy of solar wind ions.

Solar Orbiter's powerful array of ten instruments make it an ideal orbital lab, designed to study the Sun and its activity in great detail.

In-situ and Particle Instrumentation:

- Radio and Plasma Waves (RPW), led by the Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique (LESIA), Observatoire de Paris, France
- Magnetometer (MAG), led by the Imperial College London, United Kingdom
- Energetic Particle Detector (EPD), led by the University of Alcala, Spain
- Solar Wind Analyser (SWA), led by Mullard Space Science Laboratory, UK
- Heavy Ion Sensor (HIS) – this sensor is part of SWA, led by Southwest Research Institute (SwRI) in San Antonio

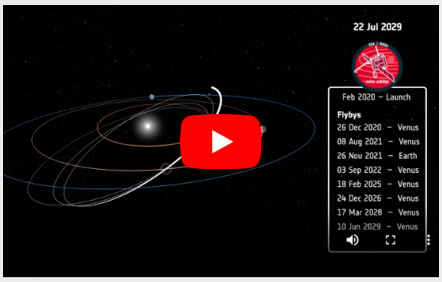
Solar remote sensing instrumentation:

- Polarimetric and Helioseismic Imager (PHI), led by Max-Planck-Institut für Sonnensystemforschung, Germany
- Spectral Imaging of the Coronal Environment (SPICE),

### Watch the video

Animation showing the trajectory of Solar Orbiter around the Sun

https://sci.esa.int/s/8930P7w

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a European facility instrument, whose operations will be led by Institut d'Astrophysique Spatiale (IAS), Orsay, France

- Extreme Ultraviolet Imager (EUI), led by the Centre Spatial de Liège (CSL) and Royal Observatory of Belgium (ROB), Belgium
- Coronagraph (METIS), led by INAF/University of Florence, Italy
- Spectrometer Telescope Imaging X-Ray (STIX), led by the University of Applied Sciences Northern Switzerland (FHNW), Windisch, Switzerland
- Solar Orbiter Heliospheric Imager (SoloHI), led by US Naval Research Laboratory, USA

The spacecraft's advanced instrumentation will help untangle how activity on the Sun sends out radiation, particles and magnetic fields. These affect Earth's magnetic environment, causing aurora, potentially damaging satellites or endangering astronauts and interfering with GPS communications or even Earth's electrical power grids.

NASA and ESA have common scientific objectives for studying the Sun, Maldonado said. "We have complementary science objectives. We get all the science data from all the instruments," she said. "We expect to see thousands of papers published globally."

NASA was also responsible for the mission launch service. Solar Orbiter flew on a ULA Atlas V 411 launched from Cape Canaveral Air Force Station, Florida.

Solar Orbiter is an international collaborative mission between ESA and NASA. ESA's European Space Research and Technology Centre (ESTEC) in the Netherlands manages the development effort. The European Space Operations Center (ESOC) in Germany operates Solar Orbiter in conjunction with the European Space Astronomy Centre (ESAC) in Spain as the mission science operations center using ground stations of ESA's tracking station network, ESTRACK. Airbus Defence and Space (ADS) in Stevenage, UK was responsible for the spacecraft development. ■

**Karl B. Hille / Code 130**
***Office of Communications***

## NASA Selects Mission to Study Causes of Giant Solar Particle Storms

NASA has selected a new mission to study how the Sun generates and releases giant space weather storms – known as solar particle storms – into planetary space. Not only will such information improve understanding of how our solar system works, but it ultimately can help protect astronauts traveling to the Moon and Mars by providing better information on how the Sun's radiation affects the space environment they must travel through.

The new mission, called the Sun Radio Interferometer Space Experiment (SunRISE), is an array of six CubeSats operating as one very large radio telescope. NASA chose SunRISE in August 2017 as one of two Mission of Opportunity proposals to conduct an 11-month mission concept study. In February 2019, the Agency approved a continued formulation study of the mission for an additional year. SunRISE is led by Justin Kasper at the University of Michigan in Ann Arbor and managed by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California.

Missions of Opportunity are part of the Explorers Program, which is the oldest continuous NASA program designed to provide frequent, low-cost access to space using principal investigator-led space science investigations relevant to the Science Mission Directorate's (SMD) astrophysics and heliophysics programs. The program is managed by Goddard Space Flight Center for SMD, which conducts a wide variety of research and scientific exploration programs for Earth studies, space weather, the solar system and universe.

Excerpted from an article by:
**Grey Hautaluoma and Karen Fox / NASA Headquarters**

Edited by:
**Sean Potter / NASA Headquarters**

# WHAT'S UP WITH FPDP Development Program?

The Flight Projects Development Program (FPDP) is a rigorous, two-year program designed to develop highly skilled flight project management personnel through an accelerated learning and development curriculum. Participants attend required and elective coursework, complete two specially selected work assignments, attend various developmental opportunities, receive comprehensive mentoring, and develop a Capstone Project.

## COHORT 4

Please welcome our new participants of the Flight Projects Development Program Cohort 4 effective April 26, 2020.

The Cohort will be very busy over the next two years and will interface with many of you throughout the course of the program. Please extend a warm welcome and best wishes for success in FPDP, and for their future careers in the Flight Projects Directorate.

### Technical Participants

Kristen Brown
Code 597

Milton Davis
Code 596

Corina Koca
Code 544

Adam Matuszeski
Code 599

Andrea Poulin
Code 544

Chetan Sayal
Code 581

### Resource Participants

Melanie Crespo
Code 201

Joseph Hickman
Code 155.7

Freda Kagere
Code 159.2

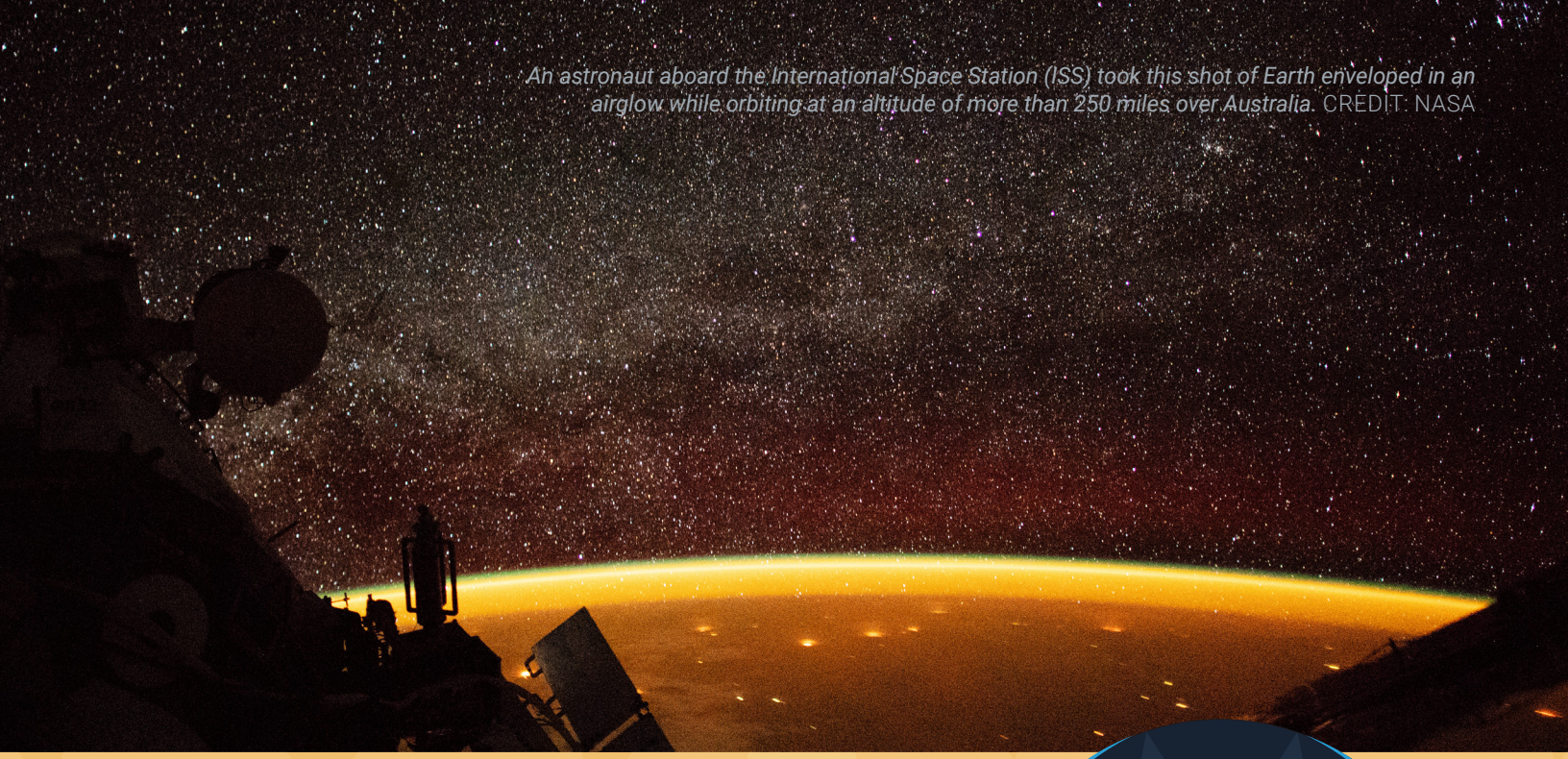
## COHORT 3

FPDP Cohort 3 is busy working on their Capstone Project, and will present their work and recommendations to the FPDP Governance Board on June 30, 2020. Ben Hall, Joe Stevens, Cathy Stickland, and Jesse Walsh are eagerly anticipating graduation from the FPDP on July 16, 2020. More to follow on Cohort 3 in the next edition of The Critical Path. ■

**Donna Swann / Code 400**
*FPD Assistant Director*
*FPDP Program Manager*

For more information about the FPDP, please look for an overview on the FPD hub, or contact Donna Swann at:

donna.j.swann@nasa.gov



*An astronaut aboard the International Space Station (ISS) took this shot of Earth enveloped in an airglow while orbiting at an altitude of more than 250 miles over Australia.* CREDIT: NASA

## Getting More Science for NASA's Dollar

# Goddard's Explorers and Heliophysics Projects Division (EHPD)

FPD SPOTLIGHT

At the intersection of scientific discovery, engineering and the facilities to make it happen, Goddard employs a host of talented individuals dedicated to helping explore our universe.

NASA and Goddard take direction from the National Academy of Sciences' Decadal Surveys to best allocate Agency resources for the study of our Sun and universe. Here at Goddard, Living With a Star and Solar Terrestrial Probes programs round up efforts to study our Sun, while the Explorers Program provides flight opportunities for small- and mid-sized explorers in both heliophysics and astrophysics.

"There's an overall plan," said Nick Chrissotimos, Associate Director of Flight Projects for EHPD.

"Part of the reason for the Decadal Surveys is to ask the questions like, what haven't we looked at in a long time? What should we go after in terms of unanswered questions? Are we maintaining the proper cadence for Explorer class missions in providing access to space for principal investigators (PIs) with current relevant scientific investigations in both astrophysics and Heliophysics?"

Goddard provides technical support and expertise for a variety of missions as well as assurance for NASA Headquarters that the missions funded are getting the best scientific value for the money invested in them. That responsibility falls on the shoulders of Mike Delmont, deputy program manager for the heliophysics-focused Living with a

## Explorers missions fit into three size categories

- Small Explorers (SMEX) class, established in the 1980s, are highly focused, relatively inexpensive space science missions in astrophysics and heliophysics. Missions include the Interface Region Imaging Spectrograph (IRIS), launched in 2013, which is observing how solar material moves, gathers energy, and heats up as it travels through the Sun's lower atmosphere. The Imaging X-Ray Polarimetry Explorer (IXPE) will be launched in 2021, and will look for answers about how neutron stars, black holes and pulsar wind nebulae produce X-rays.
- Medium-class Explorers (MIDEX) class are larger missions. MIDEX missions include the Ionospheric Connection Explorer (ICON), launched in 2019, which is studying the dynamic zone high in our atmosphere where Earth weather and space weather meet, and the Transiting Exoplanet Survey Satellite (TESS), launched in 2018, performing an all-sky survey that will discover thousands of exoplanets around nearby bright stars.
- Missions of Opportunity (MO) include recent successes like the Global-scale Observations of the Limb and Disk (GOLD) now observing Earth's thermosphere and ionosphere, and the Neutron star Interior Composition ExploreR (NICER) X-ray observatory now operating on the International Space Station. The Resolve instrument components are being delivered to the Japanese Aerospace Exploration Agency as part of the X-Ray Imaging and Spectroscopy Mission (XRISM).





Star and Solar Terrestrial Probes, and Greg Frazier, deputy program manager for Explorers.

## Frequent Flight Opportunities for World-Class Science

To explore a lot of our universe, you simply must get above the atmospheric blanket that surrounds and protects us on Earth. For many scientists around the nation's universities, however, getting funding to launch their ideas into space and access to the facilities to build spacecraft can be an insurmountable obstacle.

NASA's Explorers Program provides frequent flight opportunities for world-class scientific investigations into space. The program seeks to raise public awareness of, and appreciation for, space science as well as incorporating educational and public outreach activities as integral parts of space science investigations. Since the launch of Explorer 1 in 1958, NASA has seen more than 100 missions into orbit through the program.

Frazier helps keep many active and upcoming missions on track within the heliophysics and astrophysics science areas. Frazier's office provides innovative, streamlined and efficient management approaches and assistance to the principal investigator-led missions.

"We're a unique program," Frazier said. "The pace of our missions' development is fast; from

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selection to launch in three to four years. Most teams are small and when combined with the pace of development, it can present a challenge. The program provides advocacy, guidance and access to Goddard's skills, facilities and services."

Frazier brings more than 30 years' experience at Goddard, starting out as an engineer on the Nobel-winning Cosmic Background Explorer (COBE) mission. In addition, he has an experienced oversight team consisting of systems and mission assurance engineers on staff who oversee the missions and provide guidance. "Most of our staff developed hardware for space missions before supporting Explorers missions," Frazier said.

The principal investigator is from a university, NASA center or an aerospace company. They sometimes partner with a major spacecraft provider, so establishing a collaborative relationship between all organizations is crucial.

"The mission team works on the proposal for several years before they are selected to become an Explorers mission," Frazier said. "It is up to the program oversight team to quickly come up to speed on the mission, establish a working relationship and begin adding value to the mission. Once this is achieved, we quickly begin to work well together."

"We are advocates for missions throughout the Agency but also hold them accountable to the mission requirements they proposed," he said. "We do use a light touch to oversee a mission, but in order to do so effectively, there needs to be an almost constant flow of information between us and the PI and their team. We are partners in achieving mission success."

## Heliophysics at Goddard

Our Sun is a star, a hot ball of glowing gases that powers our solar system. Its influence reaches far beyond the orbit of Pluto. Its intense energy and heat are necessary for life on Earth. Though it is special to us, there are billions of stars like our Sun scattered across our Milky Way galaxy.

Studying the Sun occupies the continual focus of hundreds of scientists and technologists on missions across the spectrum, from smaller probes to major solar orbiters. Understanding our star and its effects on Earth is the focus of Goddard's two heliophysics programs: Living with a Star and Solar Terrestrial Probes.

These programs are comprised of a set of missions with related science goals. "Each project starts the same," Delmont said. "They are confident and they're eager to just start. They are not necessarily looking at how to team with the program office. But when problems come up, we work closer together and we are an advocate trying to help them deal with issues, stay on schedule and make the best use of their resources."

Delmont has nearly three decades' experience supporting Goddard missions with a strong engineering reliability and quality assurance background.

When problems arise, EHPD has expertise to offer in terms of people, analysis, and abilities to

help them through those issues, Delmont said. "We have a lot of people in our group who have worked on projects, headed projects. We've seen a lot of the issues that can happen."

The Living With a Star Program provides missions to improve our understanding of how and why our Sun changes, how the Earth and solar system respond, and how those interactions affect humanity on Earth and wherever we roam in the solar system. Recent missions include Parker Solar Probe, Space Environment Testbeds, and the most-recently launched Solar Orbiter Collaboration with the European Space Agency.

"That was a difficult mission in that it was a collaboration," Delmont said. "We weren't responsible for the whole mission. As difficult as it was getting the team together, we were able to do it and meet all our requirements."

The Solar Terrestrial Probes Program addresses fundamental science questions about the physics of space plasmas and the flow of mass and energy through the solar system. Program objectives are to:

- Understand the fundamental physical processes of the space environment from the Sun to Earth, to other planets and beyond to the interstellar medium.
- Understand how human society, technological systems and the habitability of planets are affected by solar variability and planetary magnetic fields.
- Develop the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers.

These objectives support NASA's strategic goal to understand the Sun and its effects on Earth and the solar system. The Earth and Sun together form the system that gives origin and sustenance to our lives. Solar Terrestrial Probes missions study the Earth-Sun system for insights into questions about how the system evolved to produce and sustain life, what will happen to this unique environment over time, and how it will affect us.

Solar Terrestrial Probe missions include:

- The Magnetospheric Multiscale Mission's fleet of four spacecraft orbiting Earth in precise formations to measure our magnetosphere.
- Solar Terrestrial Relations Observatory (STEREO) orbits the Sun on an Earth-like orbit, giving us a view of our Sun from a different perspective.
- Hinode operates multiple observatories measuring our Sun in optical, X-ray and extreme ultraviolet light.
- Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED) explores Earth's mesosphere and lower thermosphere (60 to 180 kilometers) to study their response to solar-terrestrial events.

Both Living With a Star and Solar Terrestrial Probes missions focus on specific scientific areas required to advance our fundamental understanding of the Sun–solar system connection. The current suite of 18 orbiting missions form a Great Heliophysics Observatory. Successive missions will each target the "weakest links" in the chain of understanding. The missions use a blend of in situ and remote sensing observations from multiple platforms to understand the causes and effects of solar variability as well as helping to predict space weather. ■

**Karl B. Hille / Code 130**
***Office of Communications***

EXPLORERS AND HELIOPHYSICS PROJECTS DIVISION CODE 460

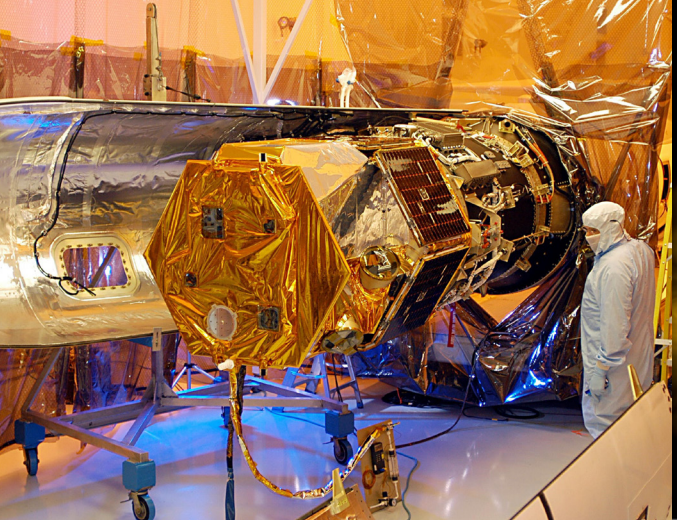
## More information

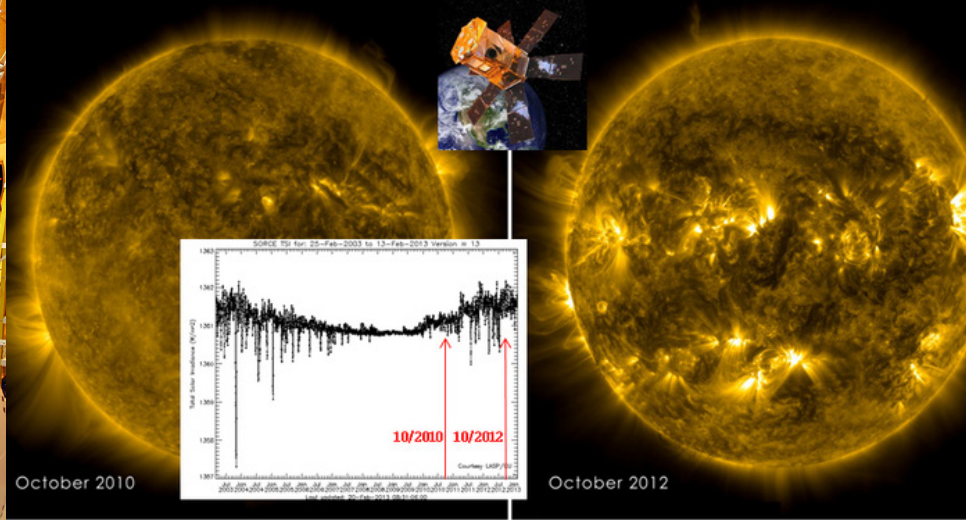
For more information on EHPD, visit:

- https://ehpd.gsfc.nasa.gov/

# SORCE ENDS ITS 17-YEAR MISSION!

*SORCE satellite in clean room before launch.* CREDIT: NASA

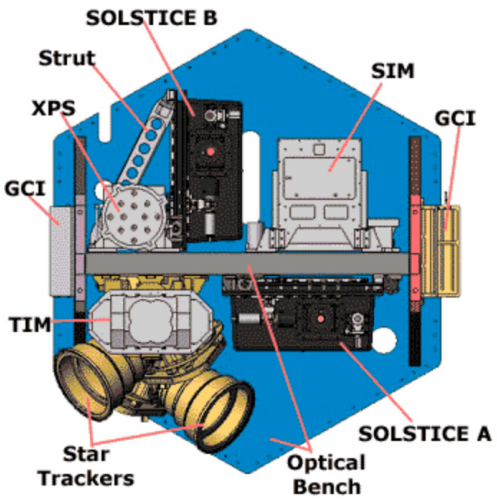





*(left) SORCE being installed into fairing at KSC.* CREDIT: KSC *(right) Total solar irradiance (TSI) data from the SORCE mission demonstrates the daily and cyclic variability of the Sun.* CREDIT: NASA/LASP

The Solar Radiation and Climate Experiment (SORCE) mission ended on February 25, 2020 as planned.

The spacecraft bus was built by Orbital Sciences Corporation (now known as Northrop Grumman Space Systems) as part of the Earth Observing System (EOS) program. The spacecraft payload was built by Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado and consists of an instrument module, including the microprocessor unit (MU), the Solar Stellar Irradiance Comparison Experiment (SOLSTICE) instrument, the Spectral Irradiance Monitor (SIM) instrument, the Total Irradiance Monitor (TIM) instrument, and the X-ray ultraviolet Photometer System (XPS). SORCE spacecraft and instruments were operated by LASP.




*Artist's concept of SORCE instrument module.* CREDIT: NASA/LASP

The SORCE spacecraft was launched January 25, 2003, aboard a Pegasus launch vehicle. The SORCE mission continued NASA's measurements of total solar irradiance (TSI) and spectral solar irradiance (SSI) for 17 years. Both measurements are key inputs for atmosphere and climate modeling, energy balance modeling and remote sensing. The mission length also enabled measurements in two of the Sun's 11-year cycles.

Although SORCE was designed as a 5-year mission, NASA extended operations to maintain the data continuity. Unfortunately, SORCE battery degradation started to impact operations after 8 years of operation. The degradation eventually resulted in insufficient power to support consistent data collection after 10 years. The mission operations team redesigned their operation concept and eventually switched to daytime-only operations in February 2014. This power-saving plan allowed the spacecraft to continue for a full 6 additional years allowing sufficient time for NASA to build and launch a replacement instrument to maintain TSI and SSI data continuity.

SORCE was a highly successful mission; its TSI measurements extended continuity of the now four-decades-long TSI climate data record. Comparisons of SORCE SSI measurements to others have also led to the production of reference SSI spectra for different phases of the solar cycle. SORCE provided the foundation for the visible and infrared portions of the SSI record. Some of the mission's top accomplishments are described on page 20.

*Continued on page 20*

*Continued from page 19*


*L-1011 aircraft with a Pegasus XL rocket containing the SORCE satellite attached underneath. Insert (left) shows the Pegasus rocket being dropped. Insert (right) shows the Pegasus rocket firing, propelling SORCE towards its orbit.* CREDIT: NASA / LASP / JEFF CAPLAN

## Mission's Top Accomplishments

1. Established a new level of TSI that is 4.6 W/m2 (0.34%) lower than prior space-based observations.
2. Acquired the first continuous measurements of SSI in the 115- to 2400-nm spectral range.
3. Defined an accurate reference spectrum of the Sun's spectral irradiance from 0.1 to 2400 nm during very quiet solar conditions.
4. Provided total and spectral irradiance inputs to the climate and atmospheric communities, and used in a wide variety of simulations and models.
5. Implemented next-generation instrumentation of spaceflight radiometers for solar irradiance monitoring with the highest accuracy and precision yet achieved.
6. Seamlessly extended the National Oceanic and Atmospheric Administration's (NOAA's) Mg II index of chromospheric activity with greatly improved spectral resolution.
7. Acquired the first solar flare measurements in TSI, and accompanying spectral variations.
8. Advanced and validated models of the Sun's total and spectral irradiance variability.
9. Observed two Venus transits and three Mercury transits of the Sun, demonstrating exoplanet detection capabilities and limitations.
10. Validated the white dwarf flux scale for absolute calibration of instruments for Ultra-Violet (UV) astronomy and made the first absolute measurement of disk integrated lunar UV reflectance.

SORCE achieved its final goal of acquiring a minimum of 12 months overlap with NASA's Total and Spectral Solar Irradiance Sensor 1 (TSIS-1). The TSI and SSI climate record is now being continued via TSIS-1 measurements.

SORCE does not have any on-board propulsion (fuel), therefore it was not possible to perform a controlled re-entry as part of the decommissioning activities. SORCE was passivated on February 25, 2020 through the disabling of the ability for the spacecraft to use the reaction wheels or to transmit radio frequencies. SORCE's orbit will slowly decay until it re-enters the atmosphere in 2032. The Orbital Debris Program Office has determined only a few small components are likely to reach Earth's surface upon re-entry with insufficient force to cause significant damage or injury.

Many thanks to all who contributed to the success of the SORCE mission! ■

**Tom Woods / Code 428, LASP**
*SORCE Principal Investigator*

**Sean Ryan / Code 428, LASP**
*SORCE Mission Operations Manager*

**Deb McCabe / Code 428, LASP**
*SORCE Flight Director*

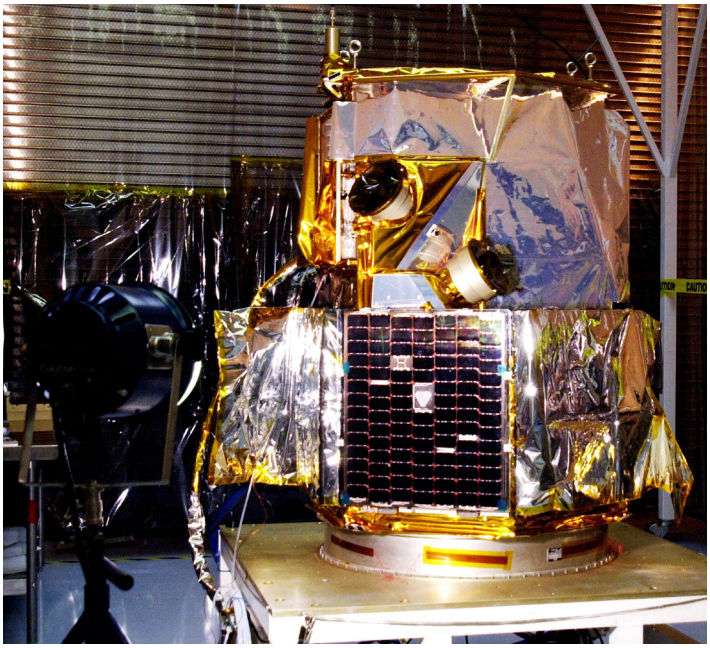
**Eric Moyer / Code 428**
*Earth Science Mission Operations Deputy Project Manager for Technical*

**Jessica Merzdorf / Code 130.0, Telophase**
*NASA Missions Science Writing and Support Specialist*

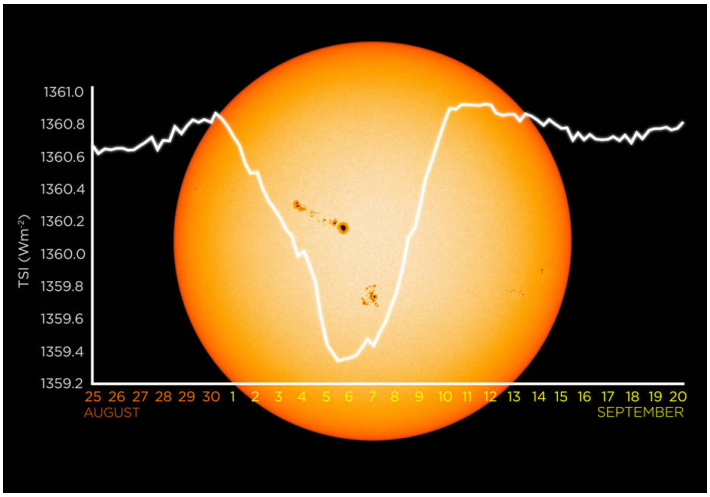
## More information

Learn more about SORCE and explore SORCE data:

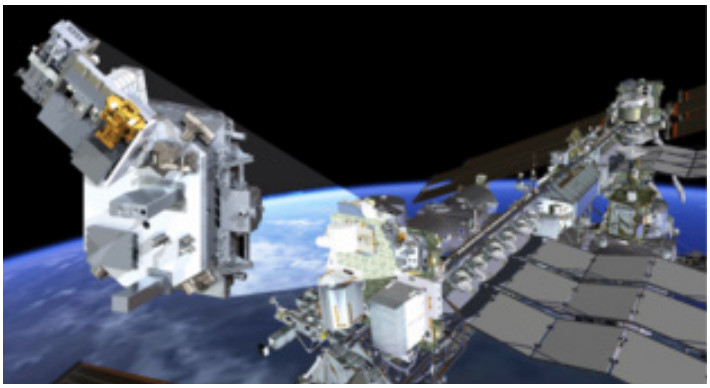
- https://eospso.nasa.gov/missions/solar-radiation-and-climate-experiment
- http://lasp.colorado.edu/home/sorce



*SORCE satellite during a solar array test at KSC.* CREDIT: KSC

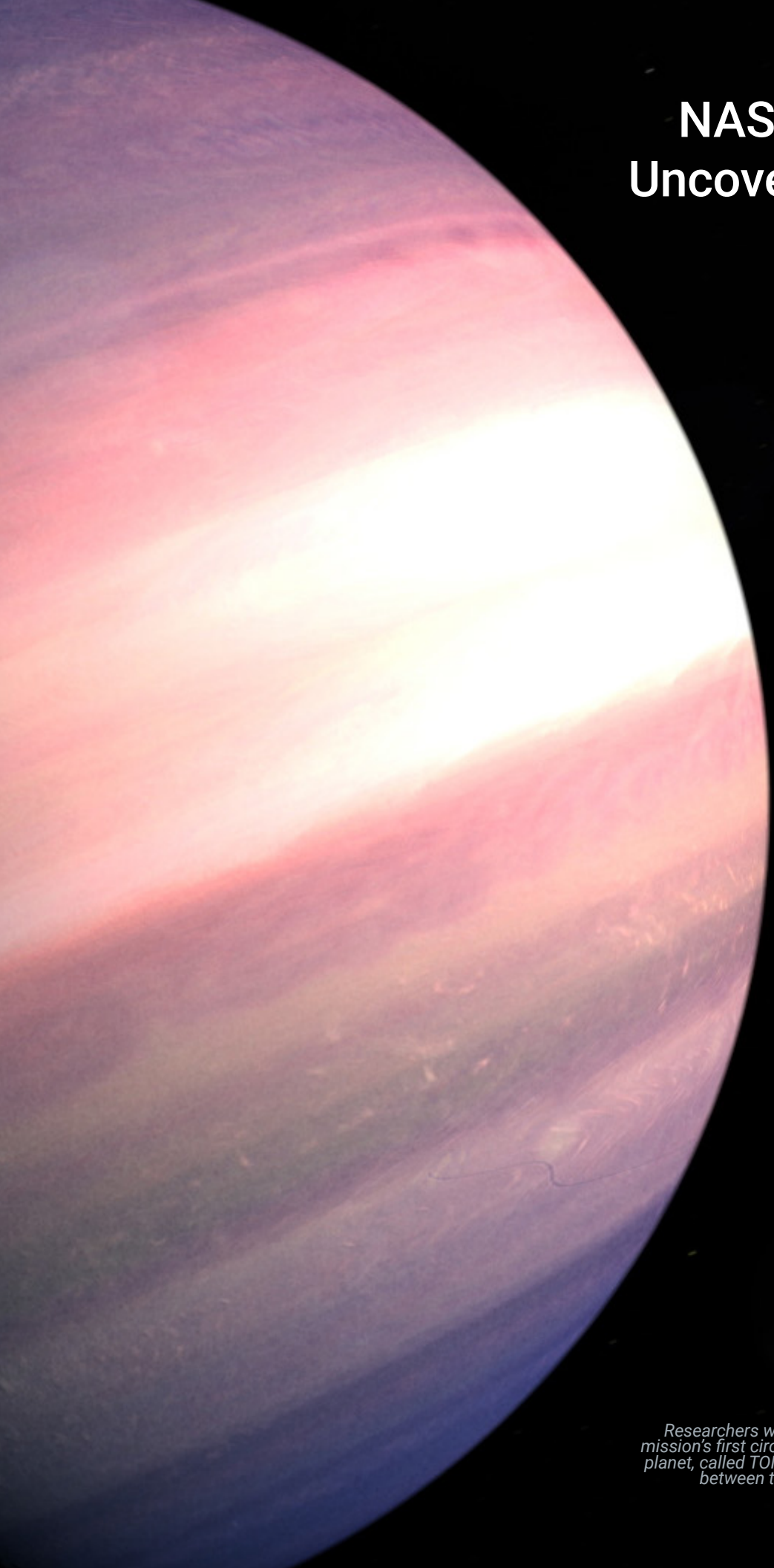



*SORCE data on total solar irradiance, the total amount of the Sun's radiant energy, throughout September 2017 showed up as measurable changes in Earth's climate and systems.* CREDIT: NASA/WALT FEIMER

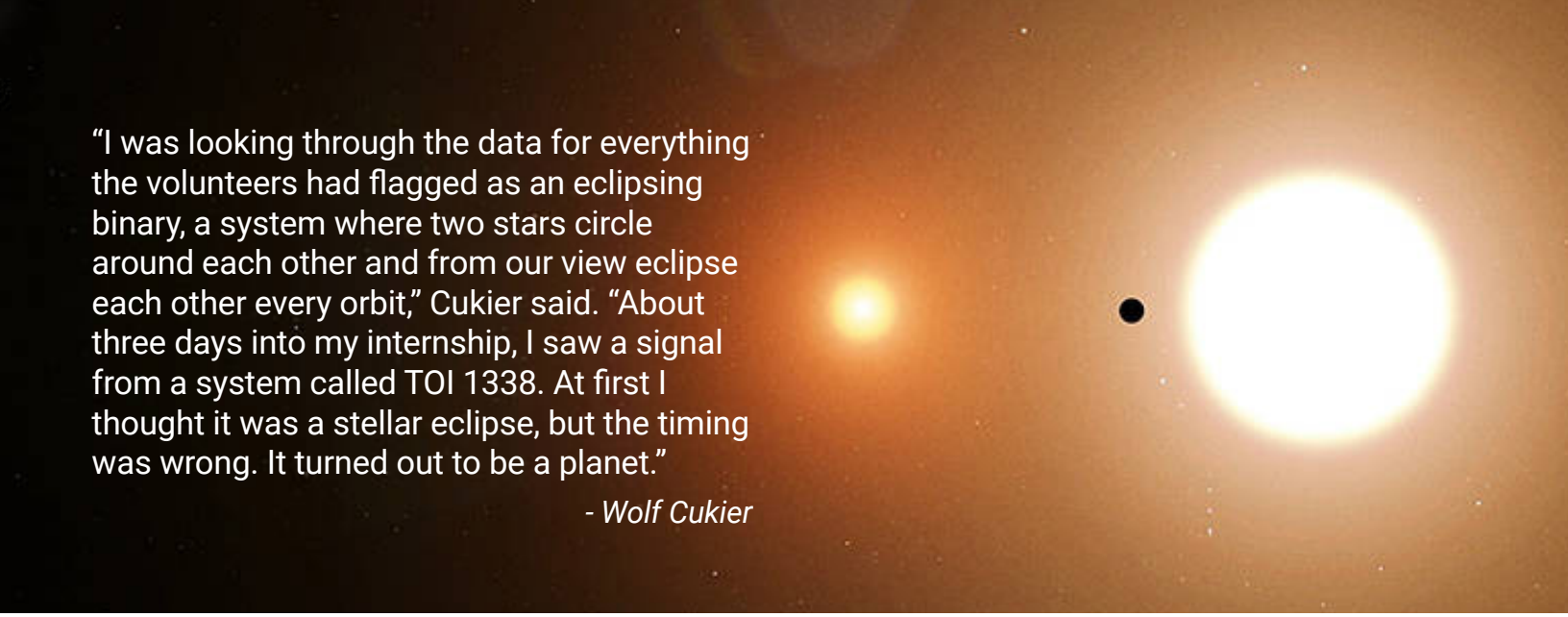


*SORCE achieved its final goal of acquiring a minimum of 12 months overlap with TSIS-1, launched December 15, 2017. Artists concept shown above.* CREDIT: NASA/LASP

# NASA's TESS Mission Uncovers its First World with Two Stars



*Researchers working with data from TESS have discovered the mission's first circumbinary planet, a world orbiting two stars. The planet, called TOI 1338 b, is around 6.9 times larger than Earth, or between the sizes of Neptune and Saturn.* CREDIT: NASA



"I was looking through the data for everything the volunteers had flagged as an eclipsing binary, a system where two stars circle around each other and from our view eclipse each other every orbit," Cukier said. "About three days into my internship, I saw a signal from a system called TOI 1338. At first I thought it was a stellar eclipse, but the timing was wrong. It turned out to be a planet."

*- Wolf Cukier*

*In this illustration, TOI 1338 b is silhouetted by its host stars. TESS only detects transits from the larger star.* CREDIT: NASA'S GODDARD SPACE FLIGHT CENTER/CHRIS SMITH

In 2019, when Wolf Cukier finished his junior year at Scarsdale High School in New York, he joined NASA's Goddard Space Flight Center in Greenbelt, Maryland, as a summer intern. His job was to examine variations in star brightness captured by NASA's Transiting Exoplanet Survey Satellite (TESS) and uploaded to the Planet Hunters TESS citizen science project.

TOI 1338 b, as it is now called, is TESS's first circumbinary planet, a world orbiting two stars. The discovery was featured in a panel discussion on Monday, January 6, at the 235th American Astronomical Society meeting in Honolulu. A paper, which Cukier co-authored along with scientists from Goddard, San Diego State University, the University of Chicago and other institutions, has been submitted to a scientific journal.

The TOI 1338 system lies 1,300 light-years away in the constellation Pictor. The two stars orbit each other every 15 days. One is about 10% more massive than our Sun, while the other is cooler, dimmer and only one-third the Sun's mass.

TOI 1338 b is the only known planet in the system. It's around 6.9 times larger than Earth, or between the sizes of Neptune and Saturn. The planet orbits in almost exactly the same plane as the stars, so it experiences regular stellar eclipses.


**Wolf Cukier**
*Student, Scarsdale High School, New York*
*Intern, NASA's Goddard Space Flight Center*


Wolf Cukier, now a senior at Scarsdale High School in New York, spent the summer of 2019 as an intern at GSFC. He has since co-authored a paper on his discovery for submission to a scientific journal.

## Watch the video

https://svs.gsfc.nasa.gov/13510

*Continued on page 24*

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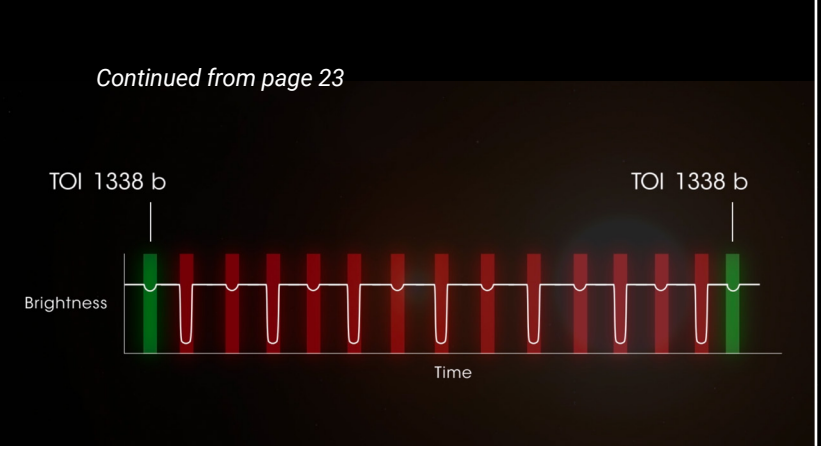
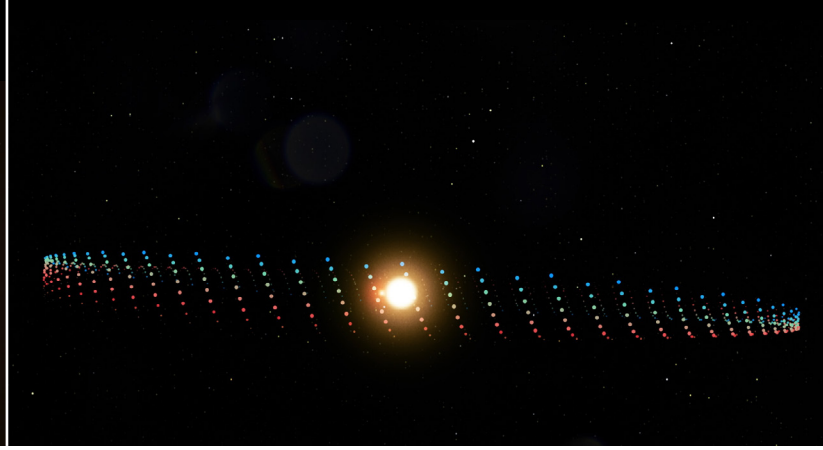


*(left) Walt uncovered transits of some of the eclipses caused by the planet. The angle of the planet's orbit around the stars changes over time. (right) After 2023, we won't see it pass in front of the stars for another 8 years.* CREDIT: NASA/GSFC

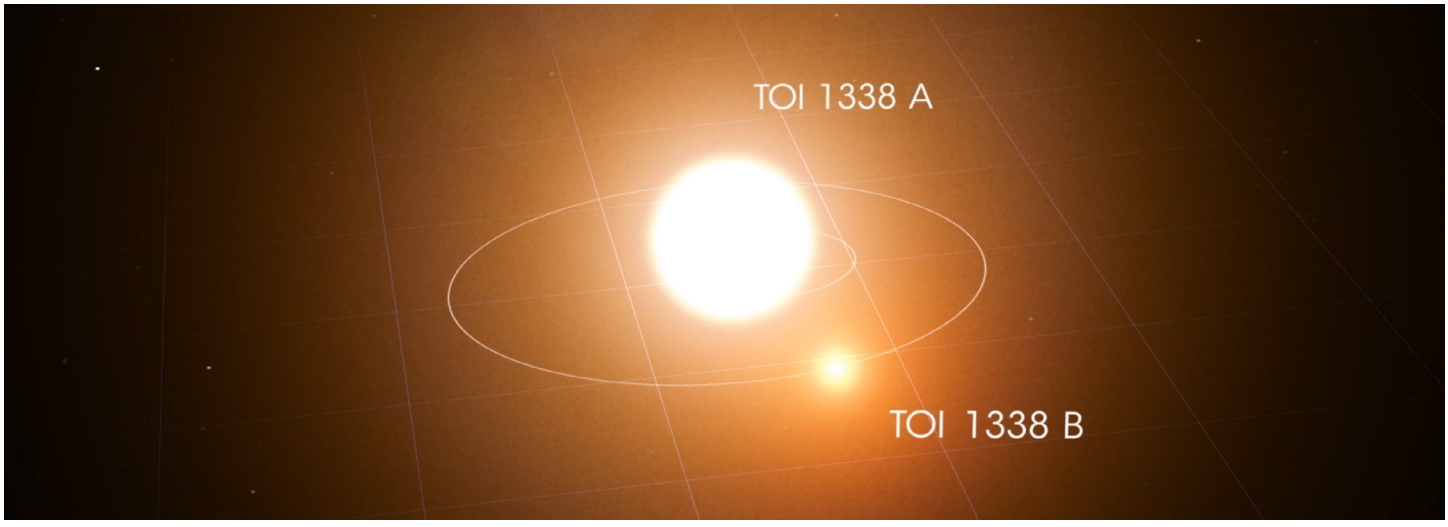
TESS has four cameras, which each take a full-frame image of a patch of the sky every 30 minutes for 27 days. Scientists use the observations to generate graphs of how the brightness of stars change over time. When a planet crosses in front of its star from our perspective, an event called a transit, its passage causes a distinct dip in the star's brightness.

But planets orbiting two stars are more difficult to detect than those orbiting one. TOI 1338 b's transits are irregular, between every 93 and 95 days, and vary in depth and duration thanks to the orbital motion of its stars. TESS only sees the transits crossing the larger star; the transits of the smaller star are too faint to detect.

"These are the types of signals that algorithms really struggle with," said lead author Veselin Kostov, a research scientist at the SETI Institute and Goddard. "The human eye is extremely good at finding patterns in data, especially non-periodic patterns like those we see in transits from these systems."

This explains why Cukier had to visually examine each potential transit. For example, he initially thought TOI 1338 b's transit was a result of the smaller star in the system passing in front of the larger one — both cause similar dips in brightness. But the timing was wrong for an eclipse.

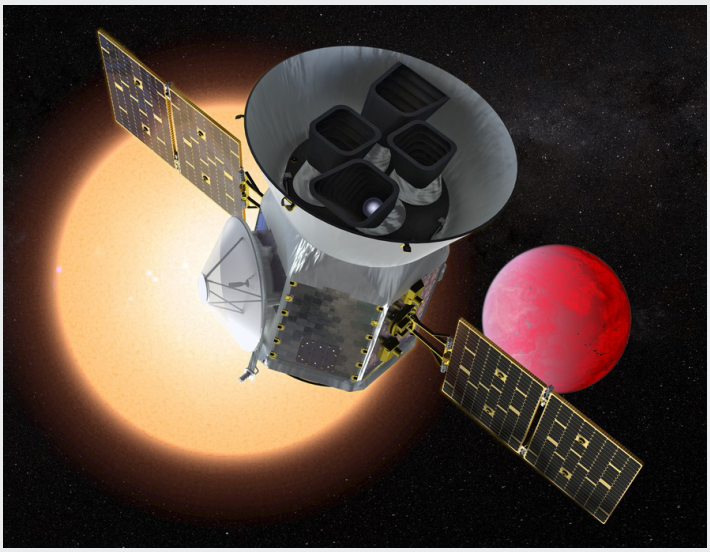
After identifying TOI 1338 b, the research team used a software package called eleanor, named after Eleanor Arroway, the central character in Carl Sagan's novel "Contact," to confirm the transits were real and not a result of instrumental artifacts. "Throughout all of its images, TESS is monitoring




*TOI 1338 is nearly the size of Saturn and orbits its stars every 95 days. The two stars orbit each other and consist of a small cool M dwarf and one much like the Sun. Together, they form an eclipsing binary, which means the stars regularly pass in front of each other from our point of view.* CREDIT: NASA/GSFC

## TESS Mission

TESS is a NASA-sponsored Astrophysics Explorer-class mission that is performing a near all-sky survey to search for planets transiting nearby stars. TESS launched on April 18, 2018 and after a series of maneuvers was placed in a highly-elliptical 13.7 day orbit around the Earth. TESS began regular science operations on July 25, 2018. In the 2-year prime mission, TESS monitors over 200,000 main-sequence dwarf stars with four wide-field optical CCD cameras to detect periodic drops in brightness caused by planetary transits. TESS was approved for an extended mission that starts in July 2020. In the extended mission, TESS will change focus to become a community science focused mission. The TESS Science Support Center (TSSC) at GSFC operates the Guest Investigator Program and supports the science community proposing for new science with TESS.



*Artist's concept of TESS in front of a lava planet orbiting its host star.* CREDIT: NASA/GSFC

millions of stars," said co-author Adina Feinstein, a graduate student at the University of Chicago. "That's why our team created eleanor. It's an accessible way to download, analyze and visualize transit data. We designed it with planets in mind, but other members of the community use it to study stars, asteroids and even galaxies."

TOI 1338 had already been studied from the ground by radial velocity surveys, which measure motion along our line of sight. Kostov's team used this archival data to analyze the system and confirm the planet. Its orbit is stable for at least the next 10 million years. The orbit's angle to us, however, changes enough that the planet transit will cease after November 2023 and resume eight years later.

NASA's Kepler and K2 missions previously discovered 12 circumbinary planets in 10 systems, all similar to TOI 1338 b. Observations of binary systems are biased toward finding larger planets, Kostov said. Transits of smaller bodies don't have as big an effect on the stars' brightness. TESS is expected to observe hundreds of thousands of eclipsing binaries during its initial two-year mission, so many more of these circumbinary planets should be waiting for discovery.

TESS is a NASA Astrophysics Explorer mission led and operated by MIT in Cambridge, Massachusetts, and managed by NASA's Goddard Space Flight Center. Additional partners include Northrop Grumman, based in Falls Church, Virginia; NASA's Ames Research Center in California's Silicon Valley; the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts; MIT's Lincoln Laboratory; and the Space Telescope Science Institute in Baltimore. More than a dozen universities, research institutes and observatories worldwide are participants in the mission. ■

**Jeanette Kazmierczak / Code 660**
***University of Maryland, College Park***

**Claire Andreoli / Code 130**
***Office of Communications***

# LCRD Team Celebrates Shipment!

On January 22, 2020, the Laser Communications Relay Demonstration (LCRD) flight payload was delivered to Northrop Grumman's facility in Sterling, Virginia. There the payload will be integrated onto the U.S. Air Force's Space Test Program Satellite 6 (STPSat-6) and prepared for launch. The LCRD will be NASA's first end-to-end optical relay, sending and receiving data from missions in space to mission control on Earth. LCRD's Space Switching Unit will enable digital communications via Ethernet from space to ground. This evolution to more internet-like communications will reduce the amount of processing required before data can be sent to science and mission operations centers.

The LCRD will demonstrate the robust capabilities of optical communications. The two boxes pictured are optical modules, which are telescopes for receiving and transmitting optical signals. Optical communications provides significant benefits for missions, including decreased size, weight and power requirements over comparable radio frequency communications systems, as well as bandwidth increases of 10 to 100 times more than radio frequency systems.

The LCRD mission is funded through NASA's Space Technology Mission Directorate and the Human Exploration and Operations Mission Directorate, and managed by NASA's Technology Demonstration Missions and the Space Communications and Navigation program offices.

**Katherine Schauer / Code 450**
***Technical Writer, Exploration and Space Communications***

*The LCRD team celebrates shipment to Northrop Grumman.* CREDIT: NASA/GSFC

*Goddard personnel inspect the LCRD payload showing the two optical modules (above) which are telescopes for receiving and transmitting optical, or laser, signals. The space switching unit (shown in the image at right) enables digital communications from space to ground.* CREDIT: NASA/CHRIS GUNN


*Cacciatore (bottom row, second from left) stands with her colleagues at the ITU World Radio Conference, held in Sharm El-Sheikh in fall 2019.* CREDIT: NASA

## Lisa Cacciatore receives appointment from U.S. State Department

The U.S. State Department confirmed Exploration and Space Communications Deputy Spectrum Manager Lisa Cacciatore as chair of the U.S. delegation for Working Party 7B (WP 7B) of the International Telecommunications Union - Radiocommunications (ITU-R) in March. In her role, Lisa leads the entire U.S. delegation to advocate for the country's radio frequency needs at ITU-R WP 7B meetings.

ITU-R is a specialized agency of the United Nations responsible for developing technical and policy recommendations for international spectrum use. The United States is one of 193-member states of the ITU. Additionally, in her role as the U.S. chairperson for WP 7B, Lisa will lead national preparatory meetings whose membership is comprised of various Federal agencies and private sector members in preparation for the international meetings.

ITU-R WP 7B is responsible for the transmission and reception of tracking, telemetry and command data for space operations, space research, Earth exploration satellite and meteorological satellite services. The working party studies communication systems for use with crewed and uncrewed spacecraft, communication links between planetary bodies, and the use of data relay satellites. ■

**Tara Dulaney / Code 450**
***ESC Strategic Communications Project Manager***

# FOCUS ON FACILITIES

Facilities Management Division (FMD) CODE 224

The Facilities Management Division (FMD) is comprised of engineers, architects, tradespeople, technicians and contractors to support maintenance, design and engineering services to enable Goddard Space Flight Center (GSFC) missions. There are positive benefits using FMD as your provider of choice although sometimes you may question the cost and seek out other means which can cause problems later on.

Within FMD's Design and Engineering Branch (Code 224), the team executes facility work through the use of a single award task order contract (SATOC). The SATOC brings many advantages to GSFC. The Federal Acquisition Regulation (FAR), which applies to all government contracts, requires competition for every contract. The SATOC was advertised as a competitive bid where contractors reviewed the FMD requirements and proposed an overall coefficient for overhead and profit, which is applied on every task order. The advantage of the SATOC is that since the contract was competed in full and open competition, the task orders do not need to be competed. The SATOC allows FMD to coordinate directly with the contractor and request a proposal for work in an efficient manner. At the fiscal end-of-year, this process is extremely valuable.

Although the SATOC is set up to move quickly, there are still regulations and United States Code that must be followed in every task order. The contract includes safety, quality, environmental and configuration management requirements as well as the design and construction requirements. The competed overhead coefficient covers the cost for management, safety, quality and environmental requirements.

The safety, quality and environmental requirements are mandatory and are enforced by agencies such as the Environmental Protection Agency and Occupational Safety and Health Administration (OSHA), as well as documentation such the Army Corps of Engineers Safety Guide: Engineering Manual 385-1-1, NASA and Goddard Procedural requirements (NPRs and GPRs), and other regulations. FMD brings value to facility design and construction because the organization deals with these requirements daily. FMD personnel are familiar with the thousands of pages that apply to each task order and the FMD contractors know what documents need to be submitted to execute and close out projects.

The cost of doing facility work for design or construction includes adhering to the contract requirements. Were you aware that all construction and demolition waste leaving Goddard is weighed and accounted for? The Environmental Protection Agency (EPA) Executive Order 13693 requires federal agencies to divert a minimum of 50 percent of the construction and demolition waste stream from landfills to a recycling center. Were you aware that all wall, door, and room number changes must be captured for configuration management? Were you aware that Safety Tool talks, Near Misses, and accidents must be reported using established safety metrics?

The FMD has the responsibility for facility work to be designed and constructed safely with established standards. When carpet is replaced or a door relocated, think about the unseen costs to get this work completed per government standards. FMD is here to enable the mission quickly and cost effectively. ■

**Bill Glenn / Code 400**
*Mission Support Manager*

# Farewell and Welcome!

Acting Center Director, George Morrow, who was also a past Director of the Flight Projects Directorate (FPD), retired from Goddard on December 31, 2019. A celebration and farewell party was held on December 16, where the current Director of FPD, Dave Mitchell, made a presentation on behalf of the FPD employees.

The new Center Director, Dennis Andrucyk, was also previously a Goddard employee, holding several positions that included the director of engineering, chief technologist, and chief of several of the Goddard engineering divisions. Prior to his current assignment, Dennis was the deputy associate administrator for NASA's Science Mission Directorate. Previously, he served as NASA's acting chief technologist and as deputy associate administrator for the Space Technology Mission Directorate. An Open House event to welcome Dennis to Goddard was held on January 21, 2020.

*George Morrow, past Director of FPD and Acting Center Director, and Dave Mitchell, current Director of FPD, at George's farewell party, held on December 16, 2019. On behalf of the FPD, Dave presented George with a commemorative collage of photos from past missions.* CREDIT: NASA/GSFC

*(left to right) Kevin Jones, Cindy Fryer, and Monica Gorman, all from the Resource Analysis Office (Code 405), welcome Dennis Andrucyk to GSFC at the Center Director's Open House on January 21, 2020.* CREDIT: NASA

# KNOWLEDGE MANAGEMENT *Insights*

## Managing Through **Disruption**

### If we name it we can manage it

"How do we describe this crisis?" participants debated in a recent webinar. Is it a "black swan" a metaphor for an extremely rare and unforeseen event with enormous impact? Or how about a "gray rhino" a highly probable but neglected threat? Or is it something else entirely?

Sense making is the instinct to attach labels and create stories when one's current experience does not match expectations. As reality unfolds, the labels we initially apply will have evolved. As we continue to learn more, the stories we share will lend meaning to what has happened. Not solely of comfort, stories can be motivating in helping move people to action.

### Disruptions present opportunities to learn

A significant disruption forces us to think. When habitual life and work patterns stop, we can no longer respond automatically. We need to make conscious decisions. This creates an opening for learning and change.

Sometimes, the busier our schedules, the more we can get stuck in a cycle of auto-response--handle emergencies—put out fires. We may keep doing things long after they no longer serve us or trouble us. According to Upstream author, Dan Heath, we may fall prey to problem blindness, the belief that some undesirable outcomes are natural or inevitable. *After all, they are out of our control*.

When we juggle a lot of problems, we can be tempted to give up trying to solve them all. Then to cope, we adopt tunnel vision. In the tunnel, there is only *forward*. When you factor in scarcity of time, the harm may not be that the big problems crowd out the little ones. Rather, it is the little problems that crowd out the big ones.

The value of upstream thinking is the ability for people to stop reacting to the big problems and focus more on preventing them. In the interest of looking upstream, this is a good time to take stock

of changes that could be made. A few questions to consider –

- What issues/lessons indicate systemic problems in my group? With time and focused attention what can be done to address or prevent them?
- Am I able to apply uninterrupted thinking time to our most complex challenges?
- What should I spend more time doing; less time doing? What activities or tasks can I delegate to offload my workload?
- What are we doing to improve the resilience of our organization? Are we developing individuals who will be ready, willing, and able to step into next level roles?
- How can my team optimize online tools and processes to add value in the current environment?
- What can we learn from our response to this crisis?

## This new reality requires working differently

We are all learning as we adapt to this environment. As you find optimal ways to manage and collaborate remotely, please share them. A few ideas to get started –

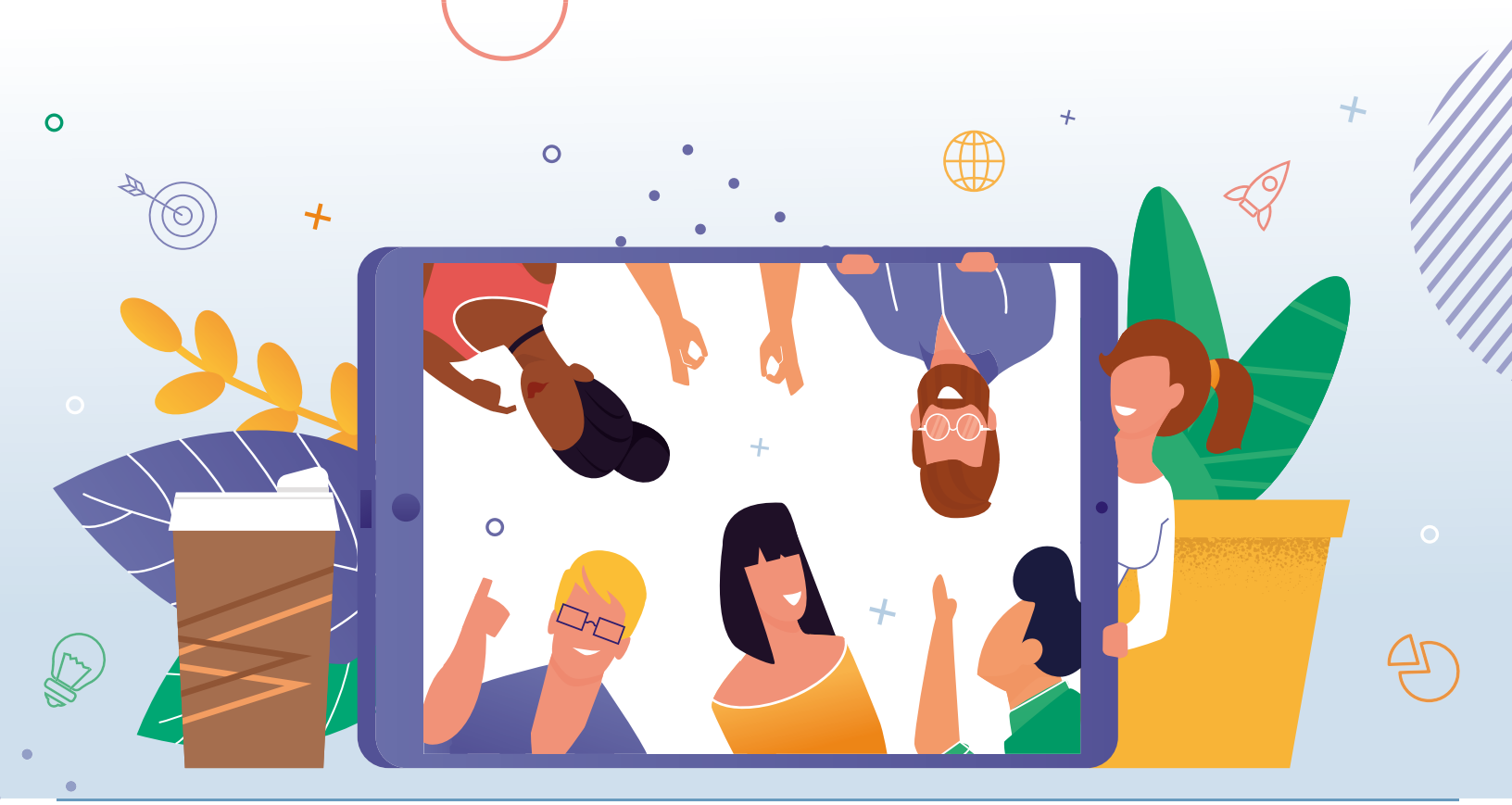
- Make information sharing a deliberate practice. Share observations, questions, and concerns. Set up morning check-ins on Microsoft Teams; keep it open for colleagues to post at will.
- Pick up the phone or start a video chat if written discussions are creating confusion or getting heated.
- The office 'water cooler' is online. Try new ways to connect such as virtual coffee breaks or lunches; offer assistance to colleagues who are new to virtual work.
- Foster greater meeting engagement. Direct questions by name; include those who do not participate in the crosstalk.
- Create feedback loops to improve virtual work processes. Have participants rate, give feedback on the formats and timing of online meetings. ■

**Judy Dickinson / Code 400**
*FPD Knowledge Management Lead*

> "The best time to plant a tree is 20 years ago. The second-best time is now."
>
> – Proverb

### For more information

- Dan Heath, Upstream: The Quest to Solve Problems Before They Happen, 2020



WE ARE IN THIS

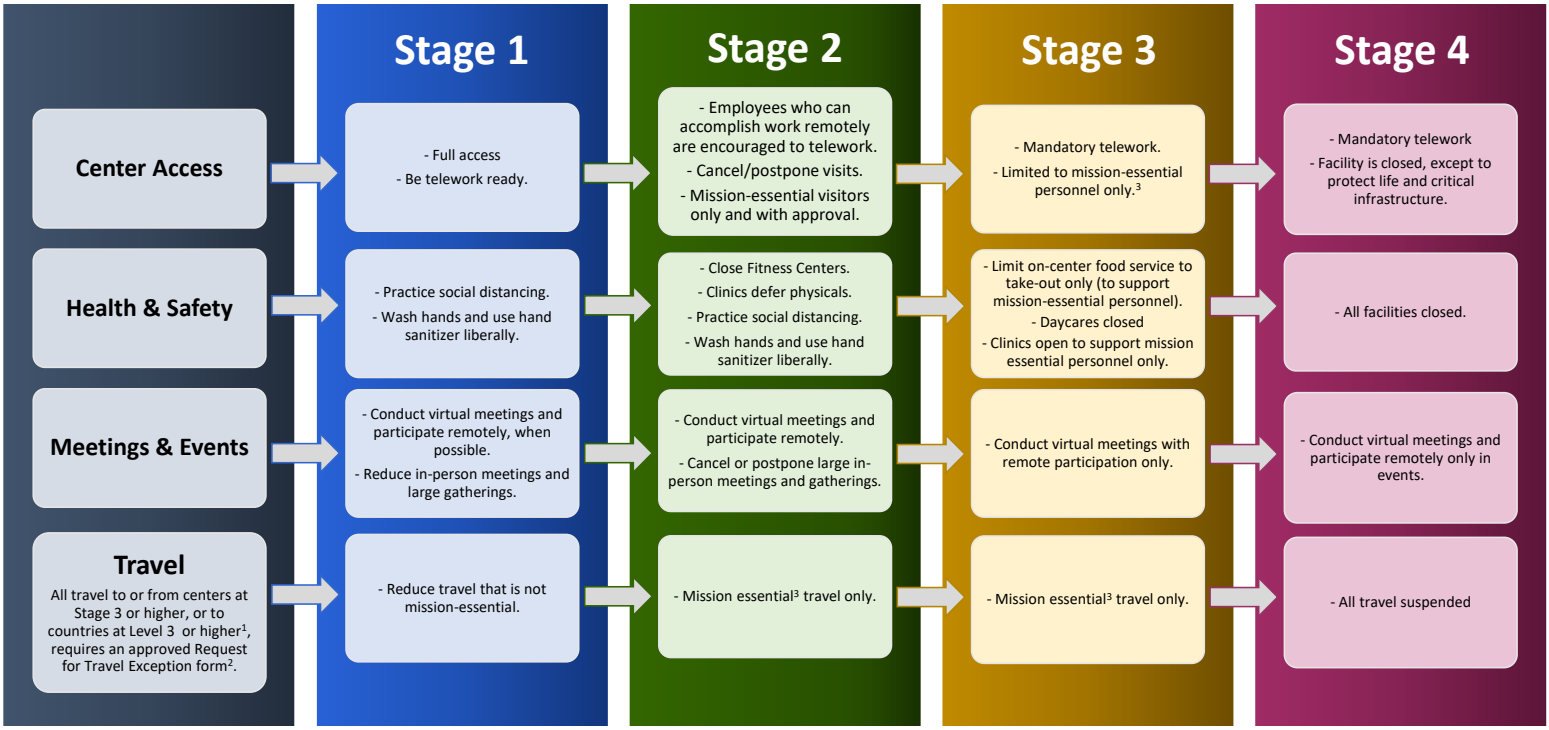
# TOGETHER

Whether we are in deep space or cyberspace, we are all OneNASA. As of late April, Goddard remains at Stage 4 of the NASA Response Framework (see next page). Please review the links under “More Resources” for the most up-to-date information. As our Center Director, Dennis Andrucyk, said recently in messages to the Goddard community, “Please remain vigilant and follow the appropriate guidelines as we work our way through this crisis. **We are all in this together**, and I hope that you and your families continue to remain safe and healthy during this challenging time …. The challenges posed by COVID-19 remain … but let’s not lose sight of the bigger picture. We are incredibly privileged to do the work that we do on behalf of the nation and humanity. At least I feel that way – and I hope you do too!! Again, please continue to look after yourselves and your loved ones, and as always, thank you for your continued commitment to NASA’s mission.”

*Thank you*

## NASA Response Framework

* This guidance applies to NASA civil servants. Contract employees should reach out to their contracting officer's representative.




1. For the latest CDC international travel information, go to https://www.cdc.gov/coronavirus/2019-ncov/travelers/index.html
2. The Request for Travel Exception form is available on the NASA People website.
3. Mission Essential is defined as: work that must be performed to maintain mission/project operations or schedules AND cannot be performed remotely/virtually; OR work that has a justifiable impact on the safety of human life or the protection of property, AND there is a reasonable likelihood that the safety of human life or the protection of property would be compromised by a delay in the performance of the work.

# More Resources

### NASA Coronavirus information site
https://nasapeople.nasa.gov/coronavirus/

- Current Stage for each Center.
- Federal and NASA guidance.
- NASA Information Technology guidance.
- Travel guidance.

### NASA Collaboration Services
https://nasa.sharepoint.com/sites/collaboration

- When to use what.

### NASA Agency and Telework Resources
https://nasa.sharepoint.com/sites/collaboration/SitePages/Remote-Collaboration.aspx

- VPN User Guide.
- Team User Guide.
- Audio Conferencing Guide.
- NASA Telework Requirements Checklist.
- **Working virtually at NASA** https://searchpub.nssc.nasa.gov/servlet/sm.web.Fetch/Working_Virtually_at_NASA_v3.pdf?rhid=1000&did=6436603&type=released
- Training, to include SATERN and other training resources.

### Employee Assistance Program

- NASA Center clinicians are available to help employees with a variety of challenges
- https://inside.nasa.gov/health4life/eap_center_contact_list

### Daily Quarantine Questions for Reflection:

1. What am I **GRATEFUL** for today?
2. Who am I **CHECKING ON** or **CONNECTING WITH** today?
3. What expectations of "normal" am I **LETTING GO** of today?
4. How am I **GETTING OUTSIDE** today?
5. How am I **MOVING MY BODY** today?
6. What **BEAUTY** am I **CREATING**, **CULTIVATING**, or **INVITING IN** today?

# FLIGHT PROJECTS DIVERSITY & INCLUSION (FP D&I)
# 2020-2021 MEMBERS

The Flight Projects Directorate (FPD) is committed not only to building awareness of diversity and inclusion activities, but also putting these critical ideas into practice and action. The FP D&I Committee strives to involve Goddard employees to respect, appreciate, and value individual differences so we can capitalize on the strengths of a diverse workforce to better perform our mission through teamwork and innovation.

In an effort to be more inclusive to those who would like to be involved but do not have time for full membership, this term we offered two ways to participate – Member or Ally.

## Members

- Participate on critical subcommittees
- Share and support D&I values
- Engage in monthly meetings and a diverse set of annual activities

## Allies

- Disseminate D&I information to organizations
- Additional opportunities available for D&I leadership positions
- Participate in D&I activities as able

Dave Mitchell, Director of FPD, and Dr. Wanda Peters, Deputy Director for Planning and Business Management and the FP D&I Committee Champion, welcomed the new Committee on January 22, 2020.

The outbreak of COVID-19 has most GSFC employees working from home and adjusting to our new normal. We also have a limited number of employees, deemed essential, traveling on-site to perform critical duties. At our FP D&I meeting in March, the committee supported each other in a discussion of the challenges of staying mission-focused while juggling: caring for/homeschooling children in the house, fear of getting sick, feelings of isolation, worrying over elderly relatives at home, nursing homes, and hospitals, and learning new IT platforms quickly, like Microsoft Teams and WebEx to collaborate with co-workers. Long days of sitting in front of computers, in back-to-back meetings, and not exercising – or even getting up to stretch or eat – was also discussed.

As we continue to navigate through the new telework environment, the GSFC Diversity & Inclusion Program Office has weekly virtual office hours, where all civil servants and contractors are welcome to participate in hour-long discussions on a variety of topics, such as Agency and Center resources, resilience strategies, navigating telework, dealing with isolation. The D&I Program Office also offered informative sessions on balancing work and family responsibilities, including caring for our children, elderly loved ones, or family and friends who have physical or mental health concerns. In an effort to help with this trying time, they are hosting weekly online stress-reduction workshops.

To learn more about GSFC's Diversity & Inclusion Program Office, please visit: https://diversity.gsfc.nasa.gov/ ■

**Donna Swann / Code 400**
***Flight Projects Diversity & Inclusion Committee Lead***

If you have any questions about the FP D&I Committee, or you'd like to get involved, please contact Donna Swann at: donna.j.swann@nasa.gov

# FP D&I 2020-2021 Members

**Legend** DI Member DI Ally

**22 Civil Servants and 15 Contractors**

Wanda Peters

Dave Mitchell

Tom McCarthy

Donna Swann

Bill Glenn

Scott Schwinger

Donita Marshall

Jerome Butler

Julie Owens

Leslie Ambrose

Celina Hanewich

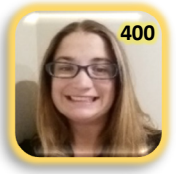
Barb Haskell

Matt Ritsko

Robert Montgomery

Jason Baldessari

Denise Byrd



Jen Poston

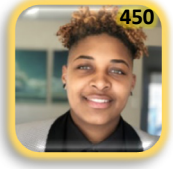
Shannon Smith

Missy Meyers

Jennifer Rose

Jonathan Dornblaser

Tara Dulaney



Reese Patillo

Elizabeth Lujan

Heidi Wood

Cathy Richardson

Tim VanSant

Hsiao Smith

James Simpson

Joana Lauderdale

Alicia Jose

Rachel Brinson

Marissa Luedtke

Glenn Hopkins

Kadie Esi

Emily Roth

Sally Lim

## Support One Another

Please continue to support one another, and if anyone would like to chat, you're welcome to reach out to any of our FP D&I members displayed above.

# Barbara Grofic

***Science Enabling Experiments for Heliophysics (SETH) (Code 470)***
**Project Manager**

**Born** Chevy Chase, Maryland – a proud graduate of Bethesda-Chevy Chase High School

**Education** BA Astronomy/Math, Smith College, Northampton, MA
MS Computer Science, Johns Hopkins, Baltimore MD

Newly appointed Project Manager for the Science Enabling Experiments for Heliophysics (SETH) Mission. Previously Deputy Program Manager/Technical on the JPSS Program.

## Life Before Goddard

Barbara grew up watching Star Trek and dreaming about being the captain of a star ship. That dream led to her joining the Astronomy Department at Smith College, where the Astronomy majors answered the office phone, "Star Fleet Academy!" She double-majored in Math and spent all her time in the computer center programming a brand new VAX 11-750, skills that landed her a job immediately after graduation with Computer Sciences Corporation, working at Goddard as an Attitude Operations Analysis for the Dynamics Explorer-A and B missions.

## Life at Goddard

Barbara had been working at Goddard for only about a year when some of the senior analysts started talking about a great new project – PASS, the ground system software project for the Hubble Space Telescope. Barbara's computer skills were a good fit, and she was accepted onto the project as a programmer. After several years on PASS she went on to support the International Halley Watch and wrote imaging processing, data analysis and mission scheduling software for Goddard's Ultraviolet Imaging Telescope, for which she also participated in operations support from the Science Operations Center at Marshall Space Flight Center. Ten years after starting at Goddard she converted to civil service and returned to Hubble as the Deputy HST Observatory Management System (HSTOMS) Manager (then Manager when the manager retired), overseeing the changes to the Ground system necessary to accommodate the servicing missions.

*Working in UIT Science Operations Center.*
CREDIT: ALL PHOTOS COURTESY OF BARBARA GROFIC

In 1998 there was a big reorganization in the Engineering Directorate and all existing Branch Head positions were re-competed. Barbara welcomed the opportunity to be part of this change, and was selected as the Real-Time Software Engineering Branch Head, a Branch that included three former branches at Greenbelt and one at Wallops. All the formerly stove-piped ground systems were brought together in one organization, setting up an environment conducive to developing the Goddard Mission Services Evolution Center (GMSEC) ground system framework. Barbara held several line management positions at the branch and deputy division level, in both software and systems engineering.

She thrived on helping her employees however she could, including encouraging them to write papers, to take training, and to take on new challenging assignments. She won funding for two Earth Science Technology Office (ESTO) technology development projects with students from Ohio University and enjoyed introducing them to Goddard and the kind of work we do. She also enthusiastically mentored interns, participated in outreach to schools, and interviewed potential engineering hires.

If there's any piece of advice that Barbara gives Goddard employees the most often, it's to stay open to new opportunities. Having a career plan is good, but be flexible enough to modify that plan when opportunity knocks. Sure enough, that happened when Barbara was approached and asked if she would be interested in becoming the first Program Systems Engineer (PSE) for the GOES R Program, to define the PSE role and staff the PSE team. Barbara learned a lot in her four years at GOES, including how rewarding team leadership is to her. Those skills would be important for her to be successful as she progressed to future leadership positions as Program Systems Engineer for the Earth Systematic Missions Program, Assistant Director in the Sciences Directorate, and Deputy Program Manager/ Technical for JPSS.

## Life Outside Goddard

Barbara lives in Glenn Dale with husband Barry and their three senior rescue dogs. Her hobbies include travel, golf, bell ringing, photography, knitting, and doing anything with their seven delightful grandchildren. ■

*(Clockwise from top left) Transporting a rescue dog, with the grandkids, in the launch control center for JPSS-1.*

*Helping kids make paper JPSS satellites.*

# Kenneth Harris

***Joint Polar Satellite System (JPSS) (Code xxx)***
**Lead Database Engineer**

**Born** Prince George's County, Maryland
**Education** B.S. University of Maryland, Baltimore County (UMBC)
M.S. Johns Hopkins University, Baltimore, MD

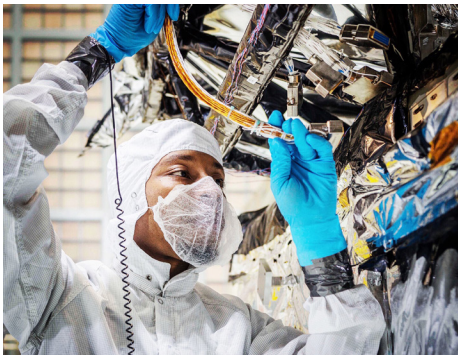
Kenneth Harris currently serves as the lead database engineer on the Joint Polar Satellite System (JPSS) J2 mission as a part of the Mission Operation Support Team (MOST). He also manages and develops procedures to control the life cycle of the database from conception to deployment.

## Life Before Goddard

Before GSFC, Kenneth was a student. He volunteered at a summer camp at age 15 and shortly after turning 16, started his career at Goddard, completing his first internship working in the Radiation Effects Department on the Magnetospheric Multiscale Mission (MMS). As a sophomore in High School, he was given the opportunity to voluntarily come on center after school and continue his work from the summer! Having a passion for the field of science, technology, engineering and mathematics (STEM), he wanted to continue to gain experience and honestly see what the data he had been working on all summer would be used for!

## Life at Goddard

Starting as an intern was a great experience at Goddard, having the opportunity to finally work at the place he visited so often as a child. During his first internship in the Radiation Effects and Analysis Department (Code 561) under the guidance of Anthony Sanders, he experienced GSFC from a work perspective for the first time. His role was to help test and collect data from semiconductors and other MMS flight components. It was a great experience and he'll never forget signing that waiver and walking into the radiation lab for the first time. Kenneth remembers thinking, "This must be how Bruce Banner felt." He adds, "Silly, I know, but being a Marvel fan I couldn't help myself; let's call it child-like nostalgia." After working on there for 2 years, he moved to the Global Precipitation Measurement (GPM) satellite, under the guidance of Alphonso Stewart (Code 543). This was one of his most entertaining internships and what Kenneth believes secured his future as a mechanical engineer. Alphonso had him assist in the development of the Solar Array Boom configuration for the large solar panels. This included designing, fabricating, and testing an elbow hinge, following the process from conception to integration. They also designed



*Kenneth helped to design, fabricate, and test harnessing for JWST.* CREDIT: NASA/GSFC: CHRIS GUNN

a series of harnesses to assist in the spring-loaded deployment of the panels. Kenneth was able to develop these designs, select and test materials to fabricate the build, understand the cost/schedule that goes into each step, and finally test the component in extreme thermal environments. This was his final High School internship before he entered college and declared a major. Amongst other factors that influenced his decision, that was the final reassurance he needed to solidify his decision. During his sophomore year of undergraduate studies, Kenneth


*Kenneth was the Keynote speaker at this year's Dr. Martin Luther King program at GSFC.* CREDIT: NASA/GSFC/TAYLOR MICKAL

completed an internship under Michelle Scott (Code 561). This was one of his first experiences working on the James Webb Space Telescope (JWST), which little did he know would change his life in the coming years.

During this internship, he worked in a lab environment performing safe-to-mate testing on harnessing. This gave him some insight into the world of electrical engineering, which then ultimately helped in certain courses he would take throughout his undergraduate degree program. He completed a Capstone project while at UMBC which contributed to the GPM project, as well as a final senior project to design a booster system for Cube Satellite Propulsion in lower Earth orbit. After graduating from UMBC, he went to the place he knew best, Goddard. Starting his full-time career, he helped to design, fabricate, and test harnessing for JWST, then moved up to leading the laboratory where the harnesses were being developed for the spacecraft. Finally, in 2016, he was given the opportunity to produce procedures and lead a team to integrate the Integrated Science Instrument Module (ISIM) Electronics Compartment onto JWST in the cleanroom. After being involved in the integration of ISIM, his mentors saw that he had a passion for the field and took a chance with him. Kenneth says, "I'm forever grateful for the opportunity to be a part of this historic project and to say I contributed in a major way to the ultimate success of the mission." Following the completed integration of JWST at GSFC and its transition into the thermal chamber at Johnson Space Center, he said farewell and moved into his current role in 2018.

## Life Outside Goddard

Outside of GSFC, Kenneth is married to his beautiful wife of 3 years. They first met in High School and then eventually started dating in college. They were married in 2016 and completed graduate school together at Johns Hopkins University. She currently works as an engineer, on some equally as cool projects. They enjoy traveling internationally and experiencing different cultures together. Kenneth enjoys cooking in his free time, experimenting with different recipes and teaching himself new techniques. He has also owned and operated a wedding photography company for the past 5 years.

Kenneth likes to take his passion for STEM beyond his career and to give back to the next generation by visiting and speaking with students as often as he can. He has given a TEDx Talk concerning his career at NASA and the guidance he received along the way. His goal is to become one of the most recognizable faces amongst the STEM community for the transparency, encouragement, and guidance he gives. He participates in both local and global conferences to spread the message concerning STEM and how we need so many of the brilliant minds out there! He has booked speaking engagements in Poland, Europe, and Germany, as well as many events within the United States. Kenneth hopes to continue to grow and meet more people willing to push the envelope and develop the STEM field even further.

Additional media presence can be found at: www.kennethfharris.com ■

# FPD Mission Updates


## Earth Observing System Data and Information System (EOSDIS)

On December 18, 1999, Terra was launched and started providing data. From 2000 to 2019, the Earth Observing System Data and Information System (EOSDIS) delivered over 2.6 million files of data totaling almost 50 petabytes to 4.6 million users around the world.


## Parker Solar Probe

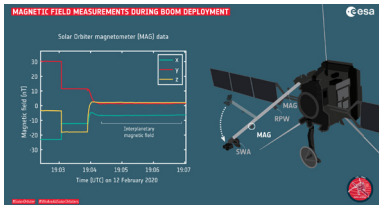
First results of the Parker Solar Probe mission were featured in 'Nature' magazine, issued December 12, 2019.


## Joint Polar Satellite System (JPSS)

The Joint Polar Satellite System (JPSS) project launched an interactive web application to help the public and other stakeholders better understand the benefits of JPSS data to their everyday lives, including its uses for weather forecasting, emergency response, and more. https://www.jpss.noaa.gov/proving_grounds/

## Tracking and Data Relay Satellite (TDRS)

The Human Space Flight Communications and Tracking Network team supported the Boeing Starliner Orbital Flight Test mission. The Space Network provided fully available Tracking and Data Relay Satellite (TDRS) service as planned and operated nominally as the mission worked through challenges.




## Solar Orbiter

The Solar Orbiter MAG instrument was the first instrument to send back data from space, on February 13, showing magnetic field measurements of the space environment before, during and after the deployment of the boom.


## Hubble

On March 30, a 30th anniversary Hubble Stargazing activity went live. The webpage provides information on ten different astronomical objects available in the April night sky for which an amateur astronomer can compare what they see vs. Hubble's images. The page can

be found at: https://www.nasa.gov/content/news-hubbles-30th-anniversary-hubble-stargazing Hubble has been selected to receive the National Air and Space Museum 2020 Collins Trophy for Current Achievement.

### Mars Atmosphere and Volatile Evolution (MAVEN)

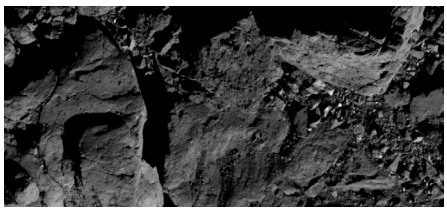
The Mars Atmosphere and Volatile Evolution (MAVEN) team supported the Mars relay network with a single Mars Science Laboratory (MSL) overflight. The 30-minute overflight returned over 1.68 GB. That is a new single relay record (for MAVEN or anyone else) and tops the previous largest overflight by over 18%.

### Mars Atmosphere and Volatile Evolution (MAVEN)

The MAVEN mission team was selected to receive the International SpaceOps Award for Outstanding Achievement for 2020. Thanks to the MAVEN team's flawless planning and execution of the aerobraking campaign in 2019, MAVEN's lifespan is expected to last beyond 2030.

### Networks Integration Management Office (NIMO)

The Networks Integration Management Office (NIMO) Human Space Flight coordinated the Antares/Cygnus NG-13 resupply of the International Space Station from Wallops Flight Facility.



### OSIRIS-REx

On March 3, the PolyCam camera on OSIRIS-REx imaged a detailed view of a large boulder that is located northwest of the sample site Nightingale. Fine-grained material is visible in the boulder's crevices and at its base. https://www.asteroidmission.org/20200303pebblesincrevices/


## Hubble Celebrates it's 30th Year!

In 2020, the Hubble Space Telescope achieves its 30th year in orbit. Hubble's unique design, allowing it to be repaired and upgraded with advanced technology by astronauts, has made it one of NASA's longest-living and most valuable observatories, beaming transformational astronomical images to Earth for decades.

Hubble has fundamentally changed our understanding of the cosmos. Throughout the year, we'll celebrate the many ways that Hubble has brought the universe home to Earth with special events in public spaces and on social media, new images, videos and documentaries, interactive features, and more.

- https://www.nasa.gov/content/hubbles-30th-anniversary

# Coming and Goings

**October 1 through December 31, 2019**

## Comings

**Michael Moreau** (595) to 444/ Space Science Mission Operations (SSMO)

**Terrance Doiron** (550) to 440/Laser Interferometer Space Antenna (LISA) Mission

**Stephanie Vidal** (224) to 401/ Project Formulation & Development Office (PFDO)

## Goings

**Rick Saylor** (458) Reassignment to 550

**Curtis Emerson** (450) Retirement

**Alicia Jose** (400) Reassignment to 660

**Nick Jedrich** (483) Reassignment to Headquarters

**Angela Butcher Mason** (420) Reassignment to Headquarters

**Art Jacques** (401) Retirement

**Al Vernacchio** (401) Retirement

**Mike Adams** (401) Retirement

## Reassignments/ Realignments Details within Code 400

**Beth Keer** (481) to 450.2/ Technology Enterprise and Mission Pathfinder Office (TEMPO)

**Thomas Martin** (450.2) to 456/Laser-Enhanced Mission Communications Navigation and Operational Services (LEMNOS)

**Joe Stevens**, FPDP (401) to 497/ Ocean Color Instrument (OCI) Instrument Project

**Steve Horowitz** (440) to 456/Laser-Enhanced Mission Communications Navigation and Operational Services (LEMNOS)

**John Deily** (401) to 417/GOES-R Flight Project

**Gene Guerrero-Martin** (421) to 411/Space Weather Follow-On (SWFO) Program

**Evette Conwell** (450) to 450.1/ Networks Integration Management Office (NIMO)

**Sergey Krimchanskey** (424) to 490/Instruments Projects Division (IPD)

**Robert Jenkens** (434) to 460/ Explorers & Heliophysics Projects Division (EHPD)

**Jason Hair** (498) to 460/Explorers & Heliophysics Projects Division (EHPD)

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Karen Rogers / Code 400
*Administrative Officer*

# OUT & ABOUT

## LIFE'S HIGHLIGHTS OFF CAMPUS

Congratulations to Joseph Hickman (460/155.7), and his wife Emily, on the birth of their son. Maxwell Brian Hickman was born at 1:03 am on February 20th. He was 20" long and weighed in at even 7 lbs.


Tammy Baker (472) was invited to share her aerospace experiences with students at Millennium High School in Goodyear, Arizona on February 28. The career fair allowed professionals from a variety of industries to talk with hundreds of students. Tammy discussed her experiences working on multiple satellite programs including the Joint Polar Satellite System. She shared pictures from TIROS-1 taken in 1960 and NOAA-20 taken last year showing the improvement in image quality. The students were especially interested in hearing about NASA's plans to return to the moon and then on to Mars.

**Share your news!**
**Weddings, births, interesting travel experiences...we want to know!**

Please send your inputs to Paula Wood. Include your **name, phone number** to:

paula.l.wood@nasa.gov
Code 460
Ext. 6-9125

# THE LATEST SAR SAVES

## NASA'S SEARCH AND RESCUE (SAR) OFFICE CONTINUES ITS EFFORTS TO DEVELOP AND IMPROVE ON LIFE-SAVING DISTRESS BEACON TECHNOLOGIES.


Each icon on this map represents one rescue event, though multiple saves may be involved with each event. The Search and Rescue Satellite Aided Tracking (SARSAT) system is able to detect three types of beacons:

**Personal Locator Beacons (PLBs)**

Used primarily by hikers and outdoor enthusiasts

**Emergency Position Indicating Radio Beacons (EPIRBs)**

Used by commercial and recreation ships

**Emergency Locator Transmitters (ELTs)**

Used by civilian aircraft

COSPAS-SARSAT rescues from April 2019 through April 2020 are shown above.

# DID YOU KNOW...?

During the coronavirus disease (COVID-19) pandemic, equal assess to information becomes critical to save lives. During press conferences from the Maryland Governor, a team of deaf and hearing American Sign Language (ASL) interpreters communicate the critical messages from the government briefings. Approximately 1.2 million Marylanders are deaf and hard-of-hearing. A Certified Deaf Interpreter (CDI) keeps the public informed by adding both context and emotion. On-screen captions, while useful, may go too quickly or lack the physical cues. Many live broadcasted addresses lack immediate captions, which could result in those who are deaf waiting for transcripts or news reports. The CDI helps provide equal and timely access to information.

### We want to be in the know!

If you have something to share, send it to Matthew Ritsko. Include your **name, phone number** and send it to:


matthew.w.ritsko@nasa.gov

Code 400 Diversity and Inclusion Committee

Ext. 6-2515

# 8 YEARS IN A ROW

# 2019 EMPLOYEE VIEWPOINT SURVEY

**For the eighth year in a row, NASA ranked #1 among the 17 large agencies in the 2019 Best Places to Work in the Federal Government rankings!**

According to the Partnership for Public Service, the nonprofit, nonpartisan group which compiles the rankings, "the 2019 Best Places to Work rankings include the views of more than 883,000 civil servants from 490 federal agencies....this includes 615,395 employees who complete the Office of Personnel Management's Federal Employee Viewpoint Survey as well as employees from 10 agencies who completed surveys with similar questions during a comparable time."

Complete rankings: https://bestplacestowork.org

## Breaking News!

The 2020 Federal Employee Viewpoint Survey is being postponed to support critical Agency missions as well as maximize employee participation in the survey. The OPM recently announced that government-wide FEVS administration is now tentatively scheduled to begin Monday, July 13, with a six-week fielding period.

**BEST PLACES TO WORK**
IN THE FEDERAL GOVERNMENT


FPD Fest
Building 8 Auditorium
11:30 am to 2:00 pm
Save the Date
October 20, 2020
Stay tuned for details on ticket sales
Tickets are $5.00 ahead and $10.00 at the door.